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PROCEEDINGS

OF THE

AMERICAN ACADEMY

OF

ARTS AND SCIENCES.

VOL. VIII.

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FROM MAY, 1868, TO MAY, 1873.

SELECTED FROM THE RECORDS.

BOSTON AND CAMBRIDGE:
WELCH, BIGELOW, AND COMPANY.
1873.

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VOL. VIII.

Five hundred and ninety-fifth Meeting.

May 26, 1868. — ANNUAL MEETING.

The PRESIDENT in the chair.

It was voted that this meeting be adjourned at its close to the second Tuesday in June, to receive the Council's Report and for other business.

The Treasurer's report was received and referred to the Auditing Committee.

At the close of his report the Treasurer declined to be a candidate for re-election.

Professor Lovering presented the report of the Committee of Publication. This report was accepted.

Professor Lovering presented the report of the Rumford Committee, which was accepted, and a recommendation to appropriate $1,000 from the Rumford Fund for beginning the publication of Count Rumford's works was referred to the adjourned meeting.

Professor Lovering declined to be a candidate for re-election to the Rumford Committee and to the Council, on account of a proposed absence from the country.

Professor Henck as chairman of the Library Committee presented their report, which was accepted.

The following appropriations were made for the ensuing year: —

For General Expenses, from the General Fund	$ 2,200.
" " " Rumford Fund	200.
For Publication	800.
For the Library	500.

Professor Rogers, as chairman of the committee appointed to consider and report on Chapter VII., Section 2, of the Statutes, reported that no change in the Statute was desirable. The subject of this report was referred back to the committee.

The following gentlemen were elected members of the Academy: —

Samuel H. Scudder, of Cambridge, to be a Resident Fellow in Class II., Section 3.

John L. Hayes, of Cambridge, to be a Resident Fellow in Class II., Section 1.

Professor W. J. Clark, President of the Massachusetts Agricultural College, to be a Resident Fellow in Class I., Section 3.

Andrew D. White, President of Cornell University, Ithaca, New York, to be an Associate Fellow in Class III., Section 2.

James B. Angell, President of the University of Vermont, to be an Associate Fellow in Class III., Section 4.

Hon. Lewis H. Morgan, of Albany, New York, to be an Associate Fellow in Class III., Section 2.

Professor T. C. Bluntschli, of Heidelberg, to be a Foreign Honorary Member in Class III., Section 1, in the place of the late Professor Mittermaier.

Professor Ritschl, of Bonn, to be a Foreign Honorary Member in Class III., Section 2, in the place of the late Professor Boeckh.

Professor Lassen, of Bonn, to be a Foreign Honorary Member in Class III., Section 2, in the place of the late Professor Bopp.

Henry Longueville Mansel, LL. D., to be a Foreign Honorary Member in Class III., Section 1, in the place of the late Victor Cousin.

The annual election resulted in the choice of the following officers for the ensuing year: —

Asa Gray, *President.*
George T. Bigelow, *Vice-President.*
William B. Rogers, *Corresponding Secretary.*
Chauncey Wright, *Recording Secretary.*
Theodore Lyman, *Treasurer.*
Frank H. Storer, *Librarian.*

Council.

Thomas Hill,
Josiah P. Cooke, } of Class I.
John B. Henck,
Louis Agassiz,
Jeffries Wyman, } of Class II.
Charles Pickering,
Robert C. Winthrop,
George E. Ellis, } of Class III.
Andrew P. Peabody,

Rumford Committee.

James B. Francis,
Morrill Wyman,
William B. Rogers,
Joseph Winlock,
Wolcott Gibbs,
Josiah P. Cooke,
Frank H. Storer.

Committee of Finance.

Asa Gray,
Theodore Lyman, } *ex officio*, by statute.
Thomas T. Bouvé, by election.

The other Standing Committees were appointed on the nomination of the President, as follows: —

Committee of Publication.

JOSEPH LOVERING, JEFFRIES WYMAN,
FRANCIS J. CHILD.

Committee on the Library.

FRANCIS PARKMAN, CHARLES PICKERING,
JOHN BACON.

Committee to audit the Treasurer's Accounts.

CHARLES E. WARE, CHARLES J. SPRAGUE.

Professor Agassiz presented the following communications: —

I. A report, dated Key West, April 24, from Mr. Henry Mitchell, to Professor B. Peirce, Supt. U. S. Coast Survey.

1. We have stretched profiles across Nicolas Channel, Santaren Channel, and Gulf Stream from Coffins' Patches to Elbow Key Light. To mention the most interesting item first: we traced a great plateau from Coffins' almost across, and in a central portion of the Straits made rich hauls of coral, living and agglomerated. Mr. Pourtales and myself are satisfied that the reef is growing out there in 200 fathoms of water.

2. We anchored boat in the axis of the Gulf Stream (as laid down on the Coast Survey chart) and quietly observed the current, — scarcely a mile per hour.

Our sounding at that point was about 550 fathoms; no variation of velocity with depth of 75 fathoms. We expected to find an increase not far below the surface, but not an inch was found. We also anchored to the westward of the middle of the Straits, and found greater velocity than in the axis, (so miscalled because warmer.)

3. Our study of Salt Key Bank and its marginal islands will interest you.

4. Nicolas and Santaren Channels are *motionless masses* of water, flat bottom, 300 to 500 fathoms, — very steep banks, say 30° to 40°. The Bahamas and Salt Key Bank are plateaux raised above the level floor of the ocean abruptly.

5. In the motionless masses of water in Nicolas and Santaren Channels (where we made four current stations at anchor in 300 and

500 fathoms) the decline of temperature from 79° (surface) to 41° (334 fathoms) is thoroughly determined. So, then, low temperatures have nothing to do with polar currents (which do not exist) or Gulf Stream.

Temperature observations are wanted in the Gulf of Providence, in this connection.

II. A report, dated Key West, May 10, from Mr. L. F. Pourtales, to the Supt. U. S. Coast Survey.

You have no doubt heard from Mr. Mitchell of the results of our cruise around the Salt Key Bank. In my line the results presented nothing of very great or novel interest, except a few dredgings on approaching the Florida reef on our return.

Since Mr. Mitchell's departure we have been engaged in running lines of soundings from the reef to deep water, combined with dredgings. At first we sounded and dredged on alternate days, but by working two lines, one on the drum and the other on the reel of the donkey engine, we find no difficulty in sounding and dredging at the same time, thus making the most of the fine weather with which we have of late been favored.

Thus far we have run four such lines and part of a fifth, and shall run two or three more. The results are very interesting and pretty accordant on the different lines. Beginning at the reef, the bottom appears to be composed of calcareous sand or mud, rather barren, until we reach near the vicinity of the 100 fathoms' line, when the descent becomes less rapid or almost ceases, indicating a rocky plateau, the material of which is a highly fossiliferous recent limestone (in fact in process of formation) in larger or smaller masses, or sometimes in ledges on which the dredge is in great danger of being held fast. This bottom is quite rich in animal life, particularly Terebratula, (my T. cubensis very abundant, and another new species a little less so), Cidaris, Comatula, and Annelids. Several species of corals occur also, nearly all different from those found on the coast of Cuba, though of the same or allied genera (Stylaster, 2 sp., Distichopora, Heliopora? and several forms of the family of Turbinolians). The Stylaster forms sometimes considerable masses. But, as I find it nearer shore, the occurrence of corals appears to be very capricious; you may get a dredge full of one species in one place, and not find a trace of them in many subsequent casts in the same neighborhood.

After we get in about 300 or 400 fathoms, which is reached by quite a rapid falling off at the end of the plateau or gently inclined plane, we find the fine sand or mud composed of Foraminifera which has so great an extension in deep water. This we make the end of our lines at present. The dredge brings up little from that bottom, but that little often of great interest. Thus I have from it a very fine Isis from 517 fathoms, and yesterday on the same bottom but less depth I obtained several specimens of a small crinoid which I have no means to determine, but which I believe to be neither a Pentacrinus nor a young Comatula. I hope to be able to dredge more over that kind of bottom on our passage home.

I have thus dwelt on the results of the last two weeks' work, because I believe them to be more important than what I did during the four preceding months, during which time I have gathered a good deal of information more or less new or useful, but which did not admit of a very connected report. I hope to make use of it in proper time.

At the suggestion of Professor Agassiz we have laid a wire strung with large conch shells from the reef at the Samboes to 10 fathoms, and are going to extend it to 20 fathoms, with the intention of examining it in a year or two and noting the corals which may have grown on the shells, and their increase of size in a given time. I had ordered tiles for the purpose before leaving Washington, but they were never sent, and at Mr. Mitchell's suggestion we took shells. I wish we had a greater variety of materials at our command, on account of what I mentioned before as the capriciousness of corals.

Five hundred and ninety-sixth Meeting.

June 9, 1868. — ADJOURNED ANNUAL MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters relative to exchanges, and a letter from Mr. Theodore Lyman, declining the office of Treasurer to which he was elected at the previous meeting.

Professor Lovering called up the recommendation of the Rumford Committee which had been referred to this meeting, and, in accordance with the recommendation, $1,000 were appropriated from the Rumford Fund for beginning the publication of Count Rumford's works.

Mr. Charles J. Sprague was elected Treasurer.

The Treasurer's report was received from the Auditing Committee and ordered to be entered on the Records.

On the motion of Professor Rogers it was *voted*, "That the thanks of the Academy be presented to Mr. John C. Lee, for the care and fidelity with which he has discharged the duties of Treasurer of the Academy."

The President called the attention of the Academy to the recent decease of Hon. Levi Lincoln and Dr. George R. Noyes of the Resident Fellows.

Nominations for election into the Academy were read.

The Corresponding Secretary read a portion of the following Report of the Council upon the changes which had occurred in the Academy during the past year, and the reading of the remainder was postponed to an adjourned meeting to be held on the fourth Tuesday in June.

During the year just elapsed, death has removed from the ranks of the Academy seventeen members, of whom *four* were Resident Fellows, *six* Associate Fellows, and *seven* Foreign Honorary Members. This loss, great as it is numerically, is even more memorable from the number of distinguished names which it embraces.

Besides the Home and Associate Members whose services to science, letters, and public affairs we shall have occasion to commemorate, our obituary list includes the names of Faraday, Bopp, Brewster, Mittermaier, Boeckh, Lawrence, and Rayer of our foreign academicians, — names which in various degrees have been familiar to the world of science and letters for nearly half a century, and of which more than one has been illustrated by researches of transcendent importance, marking eras in progress and laying the foundations of new sciences.

Of the entire list of members deceased within the year, it is perhaps worthy of note that all except three, Professor Jewett, Dr. Warren, and Francis Peabody, had reached quite an advanced age. Two of the number, Dr. James Jackson and President Day, had attained respectively to ninety and ninety-four years; five, viz. Brewster, Mittermaier, Boeckh, Lawrence, and Dewey, had reached or passed beyond their eightieth anniversary; and the remaining six, Loring, Smyth, Lord, Bopp, and Faraday, had each transcended the limit of threescore and ten years.

Of the home members whose services we desire to commemorate, we may appropriately begin our record with a notice of the venerable associate and friend whose professional skill and wisdom we have so long ranked among our social blessings, and whose gentle benignity wins us even now as if he were still among us.

Dr. James Jackson, for many years an eminent physician and the acknowledged head of the medical profession in Boston, has died during the last year at the advanced age of nearly ninety years. He was born in Newburyport in 1777, and was graduated at Harvard College in 1796. He was one of the chief founders of the Massachusetts General Hospital, and was the first and for a number of years the only physician of this institution. His clinical lectures in the hospital were continued for many years in connection with his other duties in the medical school as Professor of the Theory and Practice of Medicine in Harvard University. He was for seven years President of the Massachusetts Medical Society, and on the decease of Dr. Bowditch he was elected President of the Academy of Arts and Sciences in 1838, which office he accepted with the condition that he should retire from it on the following year.

The intellect of Dr. Jackson was capacious, logical, exact, and unwavering in its loyalty to honesty and truth. His social traits were genial, impulsive, and sanguine. Coming in his early life from the schools of European erudition, he brought with him a deep respect for the labor and learning, the authority and conventional prestige, of the then accepted luminaries of medical science. His methods of practice were in a high degree energetic and decisive. He believed, in common with many others of that day, that most diseases were susceptible of control, if not of removal, by the modes of artificial interference then generally in use. These opinions and habits were greatly modified, if not subdued, in the latter half of his long and observing life, so that although he never lost his professional fondness for the forms and implements of his art, and sometimes carried their use to a scrupulous degree of exactness, yet he became more tolerant of nature, more humble in his expectations from art, and more distrustful of reckless interference, whenever certain harm was to be balanced against doubtful good.

Dr. Jackson continued the active practice of his profession, especially as a consulting physician, and also attended annual meetings of societies to which he had been attached, for some time after he had attained the age of fourscore years. In the few last years of his life, under the joint influence of physical and mental decadence, he retired from public view. Yet he died remembered, honored, and regretted, leaving among his numerous acquaintance an appreciative freshness of memory which time had not been able to change or obscure.

Charles Greely Loring, son of Caleb and Ann (Greely) Loring, was born in Boston on the 2d of May, 1794. His ancestors on his father's side were among the earliest settlers of the colony of Plymouth. Some of the prominent traits of his character indicated his Puritan origin. From his mother, the daughter of a naval hero of the Revolution, he inherited an ardent spirit of patriotism and love of liberty.

His school-days were passed in Boston. Having completed his preparation for college at the Public Latin School, where he received a Franklin medal for industry and good scholarship, he entered the University in advanced standing in the year 1809, and was graduated with high honors in 1812. Immediately after leaving college, he became a member of the Law School at Litchfield, Connecticut, which, under the charge of Judges Reeve and Gould, was then the leading institution for legal instruction in the United States. He finished his preparatory studies for the bar in the office of the Hon. Samuel Hubbard in Boston, and was admitted a member of the Suffolk bar in the autumn of 1815. From that time, for nearly forty years, Mr. Loring continued in the active and successful practice of his profession as a lawyer and advocate, rising to be one of the acknowledged leaders of the bar, until in the year 1854, becoming somewhat weary of the conflicts of the forum and of the constant and pressing cares and labors necessarily attendant on faithful service and devotion to the interests of his clients, which had in some degree impaired a constitution never very robust, he accepted the office of Actuary of the "Massachusetts Hospital Life Insurance Company." He continued in the discharge of the duties of this important trust until his death, which took place at his summer residence in Beverly on the 8th of October, 1867.

By his first wife, Miss Ann Pierce Brace, of Litchfield, to whom he was married in 1818, Mr. Loring had four children, two sons and two daughters, who survive him.

This short and simple narrative comprises all the leading events in the life of our deceased associate, — so true is it, that a faithful and exclusive devotion of time and talent to practice at the bar in this country, while it is pretty sure to win great professional success, is quite consistent with a quiet and uneventful life. It does not necessarily lead, as in England, to wide-spread distinction. A lawyer, who resolutely eschews active participation in politics and refuses to hold official stations, rarely reaches an extended public fame. Nevertheless, the qualities of mind and character which are requisite to forensic skill, and to the attainment of a high position as a lawyer and advocate, are in many respects the same as, and in none inferior to, those which distinguish the successful politician and statesman, although they are exercised and displayed on a more narrow and less public arena. Intellectual capacity, trained and disciplined, so that it may at all times be ready for vigorous and efficient action, legal learning and wide general culture, courage, good temper and knowledge of mankind, are essential characteristics, without which the conflicts of the forum cannot be successfully carried on, or its triumphs surely won. All these qualities Mr. Loring possessed in an eminent degree. Endowed with good natural powers, he had cultivated them by long and assiduous study. His learning in all branches of the profession was affluent. He was especially distinguished for his thorough knowledge of the rules and principles of the commercial code. These he illustrated and applied to new cases with singular force, felicity, and success. The reports of cases argued and adjudged in the Supreme Judicial Court of Massachusetts and in the Circuit Court of the United States, for the first circuit during the thirty years from 1825 to 1855, furnish ample evidence of the fulness and extent of his learning, and of the important part he bore in laying the foundations and giving shape and symmetry to that branch of American jurisprudence which embraces the rights and duties of parties under mercantile and maritime contracts and transactions.

It was not solely as a sound and learned lawyer that Mr. Loring was distinguished at the bar. He was also an eloquent and persuasive advocate. His eloquence and power of persuasion did not consist merely in a strict observance of the rules of rhetoric, or in well-rounded periods, or special beauty of diction. He was master of a higher and more effective order of advocacy. Strictly conscientious, and governed in the performance of his professional duty by a rigid adherence to principle, he did not undertake the conduct of causes in the justice of which he did not fully believe. He always felt that the case of his client was a sacred trust committed to his hands. He espoused it with all the zeal and enthusiasm of his nature. He spoke in its behalf with an earnestness, sincerity, and persuasive force which flowed from conviction. This was the main source of his power as an advocate. His keen sense of justice enabled him to see and expose with cogency and clearness the injustice which others attempted to perpetrate under the forms of law; a hater of oppression, chicanery, and fraud, he never failed to detect them and to hold them up to abhorrence and scorn, with a power of speech which made even those who sought to profit by such base arts ashamed of their own wickedness; with strong and active sympathies, which led him to identify himself with the cause which he pleaded, he was always sure to gain the shortest and surest way to the minds and hearts of those whom he addressed. We speak of Mr. Loring's characteristics as they were developed in the maturity of his powers, after he had attained a foremost rank as a lawyer and advocate among such men as Webster, Mason, and Choate, — great luminaries of the bar of this Commonwealth of a generation that has now passed away. It would, however, convey an erroneous impression, if it was supposed that this professional success was gained without effort. He himself was wont to attribute it to a fixed and constant habit of industry; and certainly it is true that he was an indefatigable worker in the field of trained human labor which he had chosen. But it was not the mere love of work or the desire of success or a wish for fame which prompted this labor. It had its origin and motive in an ever-present, conscientious sense of duty. It was this great and controlling moral quality of his nature which gave fulness and completeness to his character, and secured for him an ascendency over his equals in talent and learning. The "hard uses" of the profession during a period of nearly forty years did not tarnish or impair it. He was always pure, single-hearted, of spotless integrity, and of unwavering fidelity to every trust. He trod no path but that of duty. His character and life afford signal proof that the profession of the law is as consistent with the purest moral culture as it is with the highest intellectual attainments.

It was to the labors of his profession that Mr. Loring gave the larger portion of his active life. He declined to enter into political contests or to accept public office. There was no lack of opportunities if he had desired high station. The office of Justice of the Supreme Judicial Court was offered for his acceptance. Twice he declined an appointment to the Senate of the United States; once on the resignation of Mr. Webster in the year 1849, and again in place of Mr. Everett in 1853. He was sincerely diffident of his capability for efficient public service. He feared lest his long and exclusive devotion to practice at the bar had unfitted him for the varied duties and labors of political life. Once only, after he had retired from the active pursuit of his profession, was he induced by a peculiar public exigency to serve as a member of the Senate of Massachusetts. Those who were cognizant of his eminent usefulness during this brief term of service know how great would have been the gain to the public if he had been willing to give more of his time and talents to similar labors.

But although he elected the walk of private life, and expended the strength of his mature years in the zealous and faithful performance of professional duty, he was not regardless or neglectful of the claims which the community in which he lived had on that portion of his time and talents, which would be spared from the pressing cares and labors of his regular pursuits. To the cause of education, to the institutions of religion, to public charities, to private benevolence, to social culture and intercourse, to the offices of friendship, he never failed to contribute his full share of whatever of duty or service or benefaction it was in his power to render. He served for nearly twenty years, during the busiest portions of his life, as one of the Fellows of Harvard College. For many years he was superintendent of the Sunday-school connected with the religious society to which he belonged, and always prepared himself with scrupulous fidelity to give instruction to a class of pupils under his special care. He never failed to give largely in proportion to his means to every object which seemed worthy of encouragement and support. In the social circle his frank and kindly nature, his quick and warm sympathies, and his charming conversational powers, made him always the welcome guest as well as the genial and generous host. It is not strange that a man in whose character and life so many admirable qualities were blended should have gained a wide and commanding influence in the community in which he lived. If anything had been wanting to make him the one to whom all persons turned with abiding confidence, reverence, and love, it would have been supplied by the noble enthusiasm with which he espoused the cause of the Union and the Constitution in the late civil war. Although then approaching to the allotted age of man, his ardor, energy, and zeal in the cause of his country, showed that patriotism and love of liberty had not abated one jot or tittle of their original vigor and fire within his breast. With true civic courage, in the earlier days of Southern aggression, when resistance to the demands and the power of slavery was not calculated to enlist popular favor, he had stood forth as an earnest opponent of measures designed to abridge the constitutional rights of the North, and to consolidate the power of the national government in support and defence of slavery. By speech and pen he resisted the annexation of Texas, the invasion of Kansas, and the enforcement of the laws for the surrender of fugitive slaves. When the aggressive acts of the South culminated in treason, he did not hesitate to accept the issue. Abhorrent to his kindly nature as were the horrors of a civil war, he felt that they were to be encountered fearlessly rather than to submit to a sacrifice of the rights which constitutional liberty had secured to the people of the whole country. From the breaking out of the war to its close, he was untiring in his efforts, both public and private, to aid the cause of the nation. Especially by his writings in 1862, on the subject of the relations of England and the United States growing out of the civil war; in 1863, on the rights and duties of belligerents and neutrals with special reference to the course pursued by England towards the United States; and in 1865, in his views on reconstruction, — he contributed largely to a correct understanding of the topics on which he treated, and afforded striking proof of his ability to discuss grave questions of international and constitutional law with originality, learning, and vigor.

It was Mr. Loring's supreme satisfaction to live to see the war ended, slavery abolished, peace restored, and the reconstruction of the Union in a fair way of being accomplished. It was also his grateful privilege to obey the call of his *Alma Mater* in the summer of 1865, and to preside over the commemorative festival of her sons in honor of those who had given their lives as a sacrifice for their country, and to welcome back those who had returned after brave and successful service in the field. The grace and dignity and tenderness with which this duty was performed by him will long live in the memory of those whose privilege it was to participate in the interesting services of that occasion.

The universal sorrow occasioned by Mr. Loring's death found expression from the bar, the pulpit, the bench, and the various associations with which he had been connected. "*Multis ille flebilis occidit.*" It rarely happens that the death of a private citizen is regarded as a public loss. Such was the feeling which waited on his obsequies, and no higher tribute could have been paid to his life and character.

CHARLES COFFIN JEWETT, the son of Rev. Paul Jewett, was born at Lebanon, Maine, in 1816. He was graduated at Brown University in 1835. Immediately or shortly after taking his degree, he became a member of the Theological Seminary at Andover, and completed the course of study there, yet without entering on the active duties of the clerical profession. While at Andover he commenced his bibliographical labors by preparing a catalogue of the excellent Library of that institution. The rare merit of this work attracted the attention of the few men capable of an intelligent judgment in a department of literature then much less cultivated than now, and led to the appointment which determined his subsequent course of life. In 1842 he was chosen Librarian of Brown University, and held the office for four years, combining with it for most of the time that of Professor of Modern Languages and Literature, to which he brought the preparation, not only of diligent and faithful study, but of prolonged travel and residence on the continent of Europe. He left Providence to accept an appointment as Assistant Librarian of the Smithsonian Institution, of which he very soon was made Chief Librarian. Here he distinguished himself, not only by his enterprise and skill in endeavoring to lay the foundation of a great national library, but equally by his polemic ability in advocating the policy by which he hoped that the Smithsonian fund would be devoted primarily to that end. Professor Jewett resigned this office in 1855, and his services were immediately engaged in the initial measures for the establishment of the Boston Public Library, of which, on the completion of its organization in 1858, he was chosen first Superintendent. For thirteen years he has been soul, heart, brain, and hands of this institution, systematizing and energizing every branch of its administration, inspiring its Board of Direction with his own zeal, and stimulating its benefactors to generous gifts by the assurance that the custody, arrangement, cataloguing and use of the contents of the library, would be provided for with equal wisdom and fidelity. In this charge he labored with an industry too strenuous, and with too little regard to the hygienic laws which should have set limits to his exhausting toils, till the 8th of January last, when he was suddenly stricken with apoplexy while engaged in his duties at the Library, soon became entirely unconscious, and died at his residence in Braintree early the next morning.

Professor Jewett, as a bibliographical scholar, and as a librarian both learned and judicious, has left in this country no superior, few equals. The catalogues prepared under his auspices bear ample witness to his ability and his attainments. Few, indeed, may be able to criticise the details of a work of this class; but there is no man who uses a library, whose revenue from it does not depend to a very great degree on its catalogue. An ill-made catalogue robs a library of half its practical worth and beneficent power. The citizens of Boston can hardly estimate, and cannot by any possibility overestimate, the reasons they have for holding our late associate in reverent and grateful remembrance. When we consider how large a part of what the Public Library is, and of what it accomplishes, is due to him, we might not unaptly plagiarize for him from Sir Christopher Wren's tomb in St. Paul's, and inscribe among those alcoves, "Si quæris monumentum, circumspice."

It is hardly necessary to say that Professor Jewett was an accomplished scholar, conversant with good letters, both classical and modern; had he not been so, he could not have been the bibliographer that he was. At the same time his mental gifts and endowments adorned, and were adorned by, those traits of domestic and social excellence, abounding courtesy, kindness and generosity, and Christian piety, which won for him the love in life, and the regret in death, of all who knew him, and most, of those who knew him best.

Jonathan Mason Warren was born in Boston, February 5, 1811, the son of John Collins Warren and Susan Powell Mason, his wife, daughter of the late Hon. Jonathan Mason. His grandfather was Dr. John Warren, the younger brother of Dr. Joseph Warren, whose heroism and martyrdom have made the name illustrious in our history.

At the age of nine he became a member of the Boston Latin School, then under the late Benjamin Apthorp Gould as its instructor. In 1827 he joined the class which had entered Harvard College the preceding year, but was forced to leave college after a few months on account of his health.

Finding himself at length in a condition to return to his labors, he began the study of medicine in the year 1829 under the direction of his father. This was the beginning of a life of hardly interrupted industry. Taking his medical degree in 1832, he sailed for Europe, where he remained for three years diligently pursuing his studies. On his return in 1835 he at once entered upon the practice of his profession, and, his father leaving Boston for Europe in 1859, the whole responsibility of a great professional business was thrown upon him at this early period of his career.

In 1844 he revisited Europe, and again in 1854, partly with reference to his health. But he did not receive the benefit he had hoped from this visit, and was so far from well that by the advice of Dr. James Jackson he tried the experiment of passing a winter in Rome, but without avail, and returned home an invalid, as it seemed at the time, with doubtful prospects of future health. He was at length, however, so far restored as to resume practice, and in 1857 removed to his late father's house in Park Street, devoting himself mainly from this time to Surgery.

His health was much shaken by two successive attacks of dysentery in the summers of 1865 and 1866. The death of his excellent brother, Mr. James Sullivan Warren, in February, 1867, was very depressing to him, and almost from this time his friends dated a perceptible change in his condition. In May it was discovered that a tumor was developing itself in the abdomen. He did not, however, mention the fact, and kept at his work until the first of July, when he went to his summer residence at Nahant. A fortnight later, threatening symptoms appeared, and, after many paroxysms of pain, and gradual decline of all the bodily powers, he died on the 19th of August.

Dr. Mason Warren was the third in the direct line of descent of a family which has now for more than a century been identified with the practice of Surgery and of Medicine in this town and city of Boston. He maintained and extended the reputation which he inherited. For twenty-one years he served as a surgeon at the Massachusetts General Hospital, performing more operations during this long term than any other surgeon had performed in the institution during a similar term of duty. From the first year of his entrance on professional life to the very verge of the mortal illness which had seized him, he was engaged in a most laborious and extensive practice. His skill, his devotion to his patients, his kindness, his courtesy, made him everywhere honored and beloved.

In the midst of his busy days he found time to contribute many papers to the medical journals, and in the last year of his life he gave to the world the results of his large and long experience in an elaborately finished volume of more than six hundred pages, filled with the records of many most interesting, and some extraordinary, cases.

Among the papers that he published the following may be mentioned as of special importance: —

Account of Rhinoplastic Operations performed by himself. *Boston Medical and Surgical Journal*, 1840.

Taliacotian Operation (flap divided seventy-two hours after the operation). — Successful Result. *Boston Medical and Surgical Journal*, 1843.

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In 1844, Dr. Warren received the degree of Master of Arts from Harvard University, and in the same year he was elected Fellow of the College of Physicians and Surgeons of New York. He was at a later period honored by being chosen President of the Suffolk District Medical Society, and of the Medical Benevolent Society.

Few men not pressed by urgent need have toiled so assiduously for a long course of years as Dr. Warren did to the last, in spite of all his bodily hindrances. His patients and his friends remember him with affection and gratitude, and the profession which he adorned will long refer to him as the worthy successor of an unchartered inheritance which has outlived many royal dynasties that have been for a while its contemporaries.

Dr. Warren married, in 1839, Anna Caspar Crowninshield, youngest daughter of Hon. Benjamin Williams and Mary (Boardman) Crowninshield, who survives him. He leaves six children, five daughters and a son, John Collins Warren, now studying medicine in Germany.

Jeremiah Day, the son of a Congregational minister in New Preston, Litchfield County, Connecticut, was born August 3, 1773. He was graduated at Yale College in 1795, and then took charge of the school in Greenfield, a parish of the same State, which Dr. Dwight had set up, and which he left to succeed Dr. Stiles in the Presidency of Yale College. Next Mr. Day was a tutor in Williams College, then recently founded, and after two years spent in this office accepted a similar one from his own *Alma Mater*. Here, having qualified himself to preach, he exercised his gift in the neighborhood of New Haven, until in 1801 he was attacked with hemorrhage, and was advised to go to Bermuda for his health. Soon after his departure, in the same year, the President and Fellows of Yale College gave him the chair of Mathematics and Natural Philosophy. But he returned from the island wholly unfit to discharge any college duties, and, as he thought, destined to speedy death. He took refuge at his father's house, feeble, melancholy, and apparently sinking, until a treatment of reduction which had been tried upon him was abandoned, and tonics restored him to some degree of health. In the summer of 1803 he entered on the duties of his professorship, not taking a heavy burden at first, but by degrees enabled to assume a due share of labor, and to fill his place in the College with efficiency and success. He was, however, always what may be called a man of feeble health, always obliged to take great precautions against exposure, and to govern himself by the strictest rules both as to diet and amount of exertion.

For the development of the man this trial from bodily weakness and from temporary despondency was attended with the happiest results. By nature given to prudence and moderation, he grew in these respects from his ailments; he had to study his constitution and to exercise self-control; he was obliged to be orderly and methodical; all these habits, thus learned or thus strengthened, helped his intellectual and moral nature, and he attained in this way a degree of practical wisdom which was one of his striking characteristics. The frail body, also, by discipline resisted the causes of decay, so that the man, of whose life at thirty all despaired, lived beyond the age of ninety-four with full vigor of intellect.

From 1803 until 1817 Professor Day filled the chair to which he was first appointed, and on the death of Dr. Dwight, with very great shrinking, accepted the vacant office of President. The two men were in many respects quite opposite. The one was impulsive, rhetorical, brilliant, formed to command; the other calm, philosophical, without brilliancy, unwilling to lead. But the choice, as the event showed, was a wise one. During the twenty-nine years of his presidency the College grew steadily and surely. He had the respect and esteem of all. His success showed, we think, that colleges, which often strive to find brilliant untried men for their principal officers, men unused to college ways and ignorant of that queer thing, a college-student, might do better sometimes, if they looked after a noiseless worker, experienced in his calling, honored by those around him, who has proved himself equal to all the emergencies of discipline and of instruction in the past.

At the age of seventy-three, President Day laid down his office, not because he felt any peculiar infirmities of old age creeping over him, but because he wished to resign before infirmities should weaken his judgment and lead him to outstay his time. Followed by the love of all who had known him, — among whom were all the two thousand and five hundred to whom he had given a degree, — he retired into private life, yet he was not wholly unconnected with the College, having been on his resignation chosen into the Board of Fellows. In this corporation he served until just before his death, and thus had had, as an officer and a Fellow, a share in the government of the College for sixty-seven years. His life during his retirement was serene and happy, his mind retained its strength and its interest in the affairs of the world until his last illness, and even in those two or three days before his end, the power of expression, rather than that of thinking, gave way. He closed his eyes in peace on the 22d of August, 1867, when he had reached the age of ninety-four years and nineteen days.

Perhaps the leading trait of President Day's character was the harmony of his whole nature, in which you could scarcely say what was due to native qualities, what to philosophical training, and what to Christian principle. His mind by nature had certain very valuable traits of the more solid and unpretending sort. Imagination was not remarkable among them, nor was he in any marked degree original, nor could he be called a deeper thinker than many men are. But a person familiar with him would be struck with his uncommon clearness and precision in thought and expression, with his great good sense and the perfection of his practical judgment, with the admirable method which he showed in everything. In the composition of his character, the two qualities which were nearest to the border-land of defects were caution and reserve. The latter was quite noticeable. He never spoke of himself, — neither of what he had done nor even of the maladies which had afflicted him during his later life. But his reserve, not being the effect of pride or of timidity, but rather of humility and of the absence of selfish affections, while it rendered men somewhat unfamiliar with him, detracted nothing from his power to inspire respect and veneration. So also his caution was not properly timidity, but the natural foundation of a prudence, which being under the control of principle, always carried the judgment of others with it.

His religious principle blended beautifully with a natively blameless character, so that one could not separate the two. It was not put on, but seemed as much a part of his life as were his intellectual qualities. He never spoke of himself, he showed his religious life by deeds, not by words; but there was an impression conveyed to all who knew him that he was not only a blameless but a holy man, one who "walked with God." And a spirit of sweet peace accompanied him wherever he went, together with a dignity which was the shadow cast by his pure and elevated life, which made no claims and sought no homage, but received it as an involuntary tribute.

As a man of science and of philosophical thought, President Day entered into the two fields of Mathematics and Metaphysics. From the time of his leaving the mathematical chair, upon his election to the presidency, he was almost entirely devoted to the other branch of study and instruction. During his professorship he felt the want of elementary treatises in the mathematical course which should be fitted to the peculiar necessities of American colleges. He accordingly first prepared his Algebra, which was given to the world in 1814, and from that day to this has appeared in a multitude of editions. Many years afterwards he undertook a revision of it with the help of a younger friend, which carried the resolution of the higher equations and some other branches much beyond the limits of the original work. Two years after his Algebra appeared his treatise on Mensuration and Plane Trigonometry, and in 1817 his Navigation and Surveying. These also have been often reprinted, but never had the circulation which was reached at an early day by the Algebra. Of these works, especially of the Algebra, it may be said that, while they are elementary in the strictest sense, and perhaps smooth the road too much for the learner, they have very great merits. They are clear and precise in definition, simple and elegant in explanation, proportionate in their parts; they leave no difficulties behind to embarrass the learner; they make such a selection from a wide subject as his wants seem to require, reserving the higher and abstruser parts of the science for more advanced students. In short, if the American system is a right one, of leading all the members of the younger classes, with different capacities and tastes, along the same track, nothing could be better than a work constructed on the principles which he followed in his mathematical works.

In the Department of Natural Philosophy, which then was assigned in his College to the Professor of Mathematics, he was able to undertake few or no original investigations. Without good instruments, with a very imperfect library at his command, with feeble health, he could do little more than satisfy the claims of the lecture-room and of the instructor's chair.

President Day brought to the study of Metaphysics and Morals a well-trained mathematical mind and sound common sense. In his day, Locke's reign was almost undisturbed, except so far as the Scotch philosophers had modified Locke's system. He claimed that some of Cousin's strictures on Locke proceeded from a misunderstanding of that philosopher. In the doctrine of the will he mainly followed Jonathan Edwards, and he published two treatises in explanation or defence of his views. The "Inquiry respecting the Self-determining Power of the Will or Contingent Volition," first published in 1838, and afterwards in an enlarged edition eleven years later, was suggested by a translation of Cousin's Psychology, of which he had written a review for the Christian Spectator, a journal published in New Haven. As the review was too long to embrace an examination of Cousin's theory of the will, he attempts in this work, which is a kind of supplement to the review, not only to refute Cousin's doctrine, but to set forth also his own opinions on that point of metaphysical speculation.

The other and larger work on the will, published in 1841, is a *résumé* of the work of Edwards, made in a lucid, dispassionate, truth-loving spirit, and not intended to present the views of the author himself, although he takes no pains to conceal that he is a follower of the great New England metaphysician.

We mention only one article more which came from his pen, — his essay published in the Biblical Repository for January, 1843, entitled "Benevolence and Selfishness," in which he discusses the questions of the ultimate motives of a finite being, and the end of God in the creation of the world. This essay, written partly in explanation and correction of the views of Jonathan Edwards in his work on the "End of the Creation," does great honor, as we think, to his metaphysical capacity.

Daniel Lord was born at Stonington, Connecticut, September 23, 1795.

In his early infancy his father, Dr. Daniel Lord, removed to the city of New York, where he established himself as physician and druggist. The subject of our notice, being an only child, found his chief associates among his father's friends, men of years and experience, and sometimes of rough adventure, — physicians, merchant-traders, and sea-captains, in whose conversation the observant child found ample food for thought and incentives to future action.

At school he acquired an excellent education, embracing the classical languages and French, then almost the only modern language which was recognized as an accomplishment. At the age of fifteen he entered Yale College, at that time under the charge of Dr. Dwight, and was graduated second in his class in 1814. From College he went to the Law School at Litchfield, Connecticut, whence he returned in 1816 to New York, and continued his legal studies in the office of the late Mr. George Griffin, then, and for many years afterwards, one of the most prominent lawyers of the State. He was called to the bar in 1818, and from that time until within a few weeks of his death, his life was exclusively devoted to his professional duties.

Success came slowly. But no discouragement was permitted to check his industrious pursuit of professional learning, and in those early years of patient, though often disheartened, labor he amassed the legal knowledge and secured the intellectual discipline which were the guaranty of his ultimate success.

The habits of thorough research and faithful application thus acquired, united with his vigorous abilities and his commanding moral traits, obtained at length their appropriate reward, and placed him in the front rank of his profession, at a time when the Bar of New York was made illustrious by men whose names will ever be conspicuous in the history of American jurisprudence.

The position thus won by well-directed effort was never lost by inattention or neglect. In his daily contests in the courts he was often defeated, but never unprepared. The singular uprightness of his character, always keeping him from any attempt to mislead either court or jury, gave a weight to his arguments which rendered him at all times an effective advocate and a formidable opponent. No one could accuse him of ever having tried to "make the worse appear the better reason," and he reaped the reward of his sincerity in gaining the entire confidence of those whom he sought to influence by his logic.

His life was a purely professional one. Once only he was a candidate for a seat in the New York Senate, and was defeated. Twice, however, he was invited to a position on the bench, each time by appointment to fill vacancies, — once to that of the Superior Court of the city of New York, and once to the Court of Appeals of the State. On each occasion — from no sordid motives, as all will believe who ever knew him, but from a deep-grounded distrust of the plan of an elective judiciary, then recently adopted in New York, and from a consequent unwillingness to be connected with a system which he thoroughly disapproved of — he declined the appointment.

His reputation, therefore, was simply that of a lawyer. It borrowed nothing from the prestige of official rank or authority. It was bravely fought for, and fairly won, in an arena where learning and skill could alone secure the prize, and diligence and fidelity alone retain it. The fact, therefore, that his name was so widely known, not only among his immediate associates, but throughout the land, is conclusive testimony to his great ability.

It is not in the nature of things that any private professional reputation should long survive in the minds of men, but Mr. Lord's *influence* will long outlive his *reputation*. Coming to the bar at a time when American jurisprudence was just beginning to assume its present independent position, he did much towards establishing many of its doctrines, which, though now admitted as forever fixed, were then uncertain and without authority. In some departments he was an acknowledged leader, particularly in commercial and insurance law, and the mercantile community will long be governed in some of its most important interests by principles and methods for which it is indebted to him.

The uprightness and truth which illustrated Mr. Lord's character as a lawyer and a man were the outgrowths of a true Christian faith adopted in early manhood, and matured and ripened with the reflection of advancing years, — a faith which bore fruit in Christian labors and a Christian example; which gave a hallowed tone to his influence on all around him, and at the last sustained him calmly as his end approached.

> " The man who consecrates his hours
> By vigorous effort, and an honest aim,
> At once he draws the sting of life and death."

Francis Peabody, late President of the Essex Institute, was born in Salem, December 7, 1801, and died at his residence in that city, October 31, 1867.

He was son of Joseph Peabody, an eminent merchant of Salem during the close of the last and the beginning of the present century. Soon after leaving school he travelled in Russia and Northern Europe, and on his return settled in Salem, where he continued to reside until his decease. In early life he exhibited a taste for Chemistry and the kindred sciences and their application to the useful arts, which was nurtured and developed by the literary and scientific activity of the community in which he lived, as well as by its commercial enterprise and the elevated and permanent character of its society.

When, in the year 1827, the Essex Lodge of Freemasons, of which he was a member, and the Mechanics Charitable Association, each voted to provide courses of literary and scientific lectures, Mr. Peabody entered zealously into their plans, and delivered before both of these institutions a number of lectures on the Steam-Engine, Electricity, Galvanism, Heat, and other scientific subjects. Three years later he took a leading part in the organization of the Salem Lyceum, was one of its first managers, and one of the earliest of its lecturers. For his zeal in promoting the efforts of his townsmen in this new direction he is to be ranked among the prominent founders of that system of *popular* or *lyceum lectures*, which has since become so universal in this country, and which has grown to be an influential, if not a permanent, feature of our social economy.

His taste for applied science early led him to engage in chemical and other manufactures, in which and commercial pursuits he continued to be interested until his decease.

Mr. Peabody was the first President of the Board of Trustees of the fund given by Mr. George Peabody, of London, for the promotion of science and useful knowledge in the county of Essex, which has recently been incorporated under the title of the "Trustees of the Peabody Academy of Science." He was also one of the original trustees of the Cambridge Museum of Archæology, founded by the same munificent hand, and was a member of several other scientific institutions.

Mr. Peabody was a man of active and vigorous mind, reaching out for knowledge on every side. With a genius for scientific experiments and for mechanical invention he combined a disposition, as well as ample means, to befriend the labors of others in these directions. While distinguished for the variety of his knowledge, he was indefatigable in reducing it to practical use, and was ever ready to apply his liberal means to advance the welfare of his neighbors by the encouragement of industry and the discovery of new sources of profit.

As his life was characterized by devotion to the studies and pursuits which lead to the enduring prosperity of a country, so his memory will long be cherished for his engaging virtues as well as for his active zeal in all worthy undertakings.

PROFESSOR CHESTER DEWEY, D. D., LL. D., who was elected into this society fifty years ago, died at Rochester, New York, on the 15th of December last. He was born at Sheffield, Massachusetts, on the 25th of October, 1784, and had therefore entered upon the eighty-fourth year of his age. He was graduated at Williams College in 1806, was licensed to preach in 1808, but was that same year recalled to his *Alma Mater* as tutor, and in 1810 was appointed Professor of Mathematics and Natural Philosophy (including Chemistry), which chair he occupied for seventeen years, to the great advantage of the College. Here, and afterwards as Preceptor of the Gymnasium, a high school for boys which he established at Pittsfield, and carried on for ten years, he did excellent service and acquired abiding fame as an educator. In 1836 he was called to the charge of a similar, but larger, establishment at Rochester, New York, which he conducted with great success until the year 1850, when he became Professor of Chemistry and Natural Philosophy in the newly founded University in that city. He actively performed the duties of this chair for ten years or more, when his age gave a just claim for retirement, although his powers were little impaired, and he gave occasional lectures or other services until he had reached the age of fourscore. His scientific contributions, which began in the first volume of Silliman's Journal in 1818, were continued down to within a year of his death, extending therefore through nearly half a century. These related, some of them to Physics and Chemistry, more to Meteorology, to which he paid much attention, but most of all to the one department of Botany, with which he has inseparably connected his name. His only separate botanical work was a Report on the Herbaceous Flowering Plants of Massachusetts, made by him as one of the Commissioners on the Zoölogical and Botanical Survey of the State, recommended by Governor Everett, at the suggestion of the Boston Society of Natural History, as the complement of the Geological Survey by the late Professor Hitchcock. Although much less important than the well-known reports of his colleagues, Harris, Gould, Storer, and Emerson, it shows his predilection for botanical pursuits. But, aware that other duties must mainly fill his working hours, Professor Dewey wisely selected a special department upon which he could concentrate the endeavors his leisure might allow, and turn them to permanent account. He chose the large and difficult genus *Carex* for special study, and in it became a leading authority. His " Caricography " in Silliman's Journal began in the year 1824, and finished with a general index to the numerous articles scattered through forty-three years, in January, 1867. There are very few of our about two hundred North American species with which Dr. Dewey's name is not in some way associated, and of many he was the original describer.

Professor Dewey must have been one of the latest survivors of those whose taste for natural history was developed under the lectures of Amos Eaton, when that remarkable man commenced his career as a teacher in Western New England, and in Botany, having devoted himself perseveringly to a particular department, he became the most distinguished of that school. As teacher, man of science, citizen, and Christian minister, he was a specimen of the typical Western New-Englander, — a peer among those who have not only made that district what it is, but have also in great measure founded the institutions and determined the character of the now lengthened line of States westward from the Hudson to beyond the Mississippi. Highly esteemed and honored throughout an unusually long and useful life, in his serene old age he was very greatly revered.

DR. SAMUEL LUTHER DANA died at Lowell, Massachusetts, March 11, 1868, in the seventy-third year of his age, of the effects of a fall on the ice some weeks before.

Dr. Dana was a native of Amherst, New Hampshire, fitted for college at Phillips Academy, Exeter, and entered Harvard University at the age of fourteen. Immediately after graduation he entered the army, and continued in active service as lieutenant of artillery till the close of the war of 1812. He then studied medicine, and in 1818 received the degree of M. D. from Harvard University. After practising as a physician, first at Gloucester, Massachusetts, and afterwards at Waltham, he was led by his special fondness for chemistry to give up his practice in order to engage in the manufacture of oil of vitriol and other chemicals. Having continued to superintend the works of the Newton Chemical Company for many years, he was in 1833 induced to accept the position of Chemist of the Merrimack Print Works in Lowell, a position which he held for the rest of his life.

With a breadth of view deserving of all praise, the founders of the Merrimack Manufacturing Company saw the importance of bringing science to the aid of art, and, from the outset, considered a regular chemist as indispensable in their print-works. When the first vacancy occurred, they were particularly fortunate in securing the services of Dr. Dana. Having an ardent love for science, rare aptness in tracing out causes, and untiring perseverance in applying principles to practice, he thenceforth devoted himself most industriously to matters connected with calico-printing. The first requisite for a good print is the thorough bleaching of the cloth. Dr. Dana made a full study of this subject, and succeeded in diminishing the number of operations which had before been deemed essential. His ideas were made known to the world by a communication sent to the Société Industrielle de Mulhouse, and published, in part, in their Bulletin in 1836. His plan at first met with some opposition, but is now very generally used, and is commonly known as the "American method" of bleaching.

One of his earliest investigations related to the action of cow-dung in clearing calico of the thickening used in printing on the mordant; and he was thus naturally led to inquire into the nature of manures in general, and of the products of decay, then little understood, but afterwards more fully investigated by Malden and others, and distinguished as gein, humin, and ulmin. The collateral knowledge thus acquired was freely communicated to various friends, and awakened so great an interest that he was urgently requested by some of his appreciative fellow-citizens to deliver a course of lectures on the Chemistry of Agriculture. The request was complied with in the winter of 1839–40. The publication of these lectures being solicited as likely to prove of great advantage to the agricultural interests of the Commonwealth, Dr. Dana condensed his notes into a pithy treatise, which was issued in 1842 under the quaint title of "A Muck Manual for Farmers," — a name indicative of the prominent idea of the work. Five editions of this book have been published in this country, and it has been reprinted in England. At the suggestion of Dr. Warren, he also wrote an Essay on Manures, for which a prize was awarded by the Massachusetts Society for promoting Agriculture. These labors awakened in his own mind such an interest in the tillage of the soil, that he bought a farm near Lowell for the purpose of testing his particular views, and successfully directed its cultivation for many years. He seems to have found no occasion to modify the propositions which he laid down at first; though he might have seen fit to add some limitations to one or two of them, had he tried the unctuous bottom lands of the Mississippi Valley as well as the light soils of Middlesex County.

In point of time, originality, and ability, Dr. Dana stood first among scientific writers on Agriculture in this country, and his works have done great good. But the agricultural treatises by which he has become so well and favorably known were but the secondary results of his inquiry into the nature of cow-dung as related to calico-printing. The primary object was pursued with signal success. He found that the property of fixing mordants was owing, in a great measure, to the presence of phosphates, and that the cumbrous and costly animal excrement might be effectually replaced by cheap soluble phosphates prepared from bones. As the discovery came to be rendered fully available in the regular routine of work, the fifty cows which had been constantly kept by the Merrimac Company were sold off, and a few barrels of burnt bones were occasionally brought into the Works under a name understood only by the initiated. Dr. Dana as an employee of the Company was not allowed to secure a patent for the invention, and thus received no personal benefit from it, though it has effected an immense saving to others. But another person, with a full knowledge of what had been done at the Merrimac Print Works, went to England and sought to turn the discovery to account there; and it was then found that Mercer had at the same time been making similar trials. In fact the English and the American chemist independently originated the use of dung substitutes. But probably to Mercer must be conceded the priority of experiments by a few months, while Dana was the first to make the substitution a complete success in actual practice. Neither gained full credit for the discovery, because in neither case was the matter made public till Mercer, finding himself not to be in exclusive possession of the idea, joined with others and patented the use of phosphates and arseniates for dunging.

In 1840, Dr. Dana, at the request of the city government of Lowell, made a careful examination of the various well-waters of the city, with reference to their action on lead pipes. And his interest in this important sanitary matter did not end with the presentation of his well-digested report; but for the sake of making generally known the insidious danger then so little understood by physicians themselves, he supervised the translation and publication of Tanquerel on Lead Diseases, with valuable annotations, — the work of translation being done chiefly by his daughters.

In 1851 the manufacture of rosin-oil was brought to his notice, and he contributed much to the improvement of that branch of industry.

In 1860, Dr. Dana gave his library, containing many rare and valuable chemical books, to Harvard and Amherst Colleges.

From the excellence of what he published, we might have expected a valuable work on general agricultural chemistry, had he been able to fulfil the partial promise made at the close of his prize Essay on Manures. But in later years his time was occupied by the daily duties of his position and the management of his farm, his health not always allowing him to labor as actively in scientific matters as his ever-lively interest would prompt. Dr. Dana was so quiet as well as accurate and thorough in his work, and so concise in the expression of his thoughts, that he could be fully appreciated by few. But his earnest devotion to truth, the precision and extent of his knowledge, his high sense of honor, and his conspicuous integrity of character, commanded the fullest respect and confidence of all who knew him.

PROFESSOR WILLIAM SMYTH was born in Pittston, Maine, February 2, 1797, but in his childhood his parents removed to Wiscasset, which was his home till he entered college. The story of his early struggles to obtain a liberal education, of his indomitable perseverance, his self-sacrificing, independent spirit, and the success and reputation of his subsequent life, furnishes most valuable lessons for the young. His preparatory course for college he pursued alone, without regular instruction, at intervals of work as a teacher; the last two years at Gorham, Maine, where he was an assistant in the Academy with Rev. Reuben Nason (Harv. 1802), an accomplished classical and mathematical teacher, whose counsel and aid he always gratefully acknowledged. He entered Junior at Bowdoin, September, 1820; and, though from late hours of preceding years over Greek and Latin he was compelled to study by another's eyes (his lessons being read to him by his chum), he graduated, 1822, with the first honors of an able class. In 1823 he received appointment as Proctor and Instructor in Greek at his own College, and, soon after, as Tutor in Mathematics and Natural Philosophy.

Thus called to a new department of instruction, he detected in himself and revealed to others the peculiar talent — it may be said, original power — which has given him so much of a name, and reflected so much reputation on his *Alma Mater*. The predilection of the student had been decidedly for Greek. His success, however, rarely equalled, as a teacher of Algebra, excited quite an enthusiasm in his classes, and thus was designated the eminently fit person to relieve Professor Cleaveland, who had held that department from the opening of the College, and had added Chemistry and Mineralogy to the list of his multifarious duties. In 1825 he became Adjunct Professor of Mathematics and Natural Philosophy, and in 1828 full Professor.

With the deep enthusiasm of his nature he at once gave himself to the study of the French systems; read the *Mécanique Celeste*, and soon began the work of preparing text-books for his classes. In 1830 he published an Algebra, which was among the first in this country in which the French method was employed. This passed through several editions and then gave place to two separate works, the Elementary and the Larger Algebra. There followed, in rapid succession, Treatises on Plane Trigonometry and its Applications, on Analytical Geometry, and the Calculus, of this last a second edition appearing in 1859.

A man of quick sensibility to questions of right and wrong, of deep religious principle, and of ardent and indefatigable nature, he could not be indifferent to any worthy object of philanthropy or of public interest. His enthusiasm was fired by the struggles of the Poles for national life, and then by the Hungarian Revolution. He studied the strategy, was familiar with every phase, political or military, of those movements, and with the qualities of the leaders. As an earnest Christian man, he could not but feel a lively concern in the case of the Cherokees in our country, as a great question involving national justice and honor. He early took decided position in the slavery discussion, and, besides writing in the public press, prepared some of the ablest papers which the antislavery cause called forth. The common schools of Maine are more indebted to him than any other man for his agency in favor of the "graded system." He was active, influential, self-denying in behalf of the church and congregation with which he was associated. His decided mechanical skill was freely bestowed in superintending the erection of the new church edifice near the College and in the principal brick school-house of the village. His last work of this sort was the preparation for the Memorial Hall to commemorate distinguished alumni and friends of the College, especially those who served with honor in the war of the Rebellion. All his energy and skill he threw into this which he was wont to regard as his last work. He was consulting with a contractor on the grounds, when he was seized with the fatal symptoms which, after a little more than two hours of suffering, terminated in death.

Since our last annual meeting, Physical Science has lost, by death, the distinguished services of three of its devotees, — Faraday, Brewster, and Foucault. Of the last two, one was the veteran associate of the French Academy of Sciences, the other the youngest member of his section, already great, however, in achievement as well as in promise; and both of them in the fulness of their strength and usefulness.

MICHAEL FARADAY was born September 20, 1791; the son of a blacksmith in Newington Butts, Surrey, England. He died in the apartments in Hampton Court Palace, which the Queen had assigned to him, on August 25, 1867: and with him went out the brightest light which had radiated through the chemical and physical sciences for forty years.

In 1804, at the age of thirteen, and with a scanty education, Faraday was sent to a bookbinder, with whom he served an apprenticeship of eight years. But he was not toiling these many years merely upon the *outside* of books. He felt through his whole life his indebtedness to the works of Mrs. Marcet, and he says: "Whenever I presented her with a copy of my memoirs, I took care to add that I sent them to her as a testimony of my gratitude to my first instructress." A copy of the *Encyclopædia Britannica*, sent to be bound, riveted Faraday's attention; particularly the article on Electricity. Out of an old bottle he constructed his first electrical machine, and out of a medicine-phial a Leyden Jar, and, thus equipped, he began to experiment. It is to be observed, however, that a great many other boys have done the same thing without growing up to be Faradays. But with them it was play, with him it was work. Faraday himself, in later years, attached considerable importance to the habit which he acquired in early life of repeating, as far as he was able, the experiments of which he read in Chemistry and Electricity. And when, afterwards, the brilliant lecturer enchanted both young and old, he treated his audiences as he had treated himself. He did not suppose them to know, or require them to believe, in any physical law, however familiar, unless he had shown it to them; not even that a stone would drop to the earth, without dropping it first before their eyes on to the floor of the lecture-room.

In 1812, Faraday was invited to the Royal Institution, to hear Sir Humphry Davy lecture. He took notes at these lectures which he afterwards sent to Davy, asking at the same time his assistance to escape from trade and dedicate himself to science. Davy, who was then at the zenith of his transcendent popularity, had the time and the disposition to encourage the youthful aspirant, and in March, 1813, Faraday became chemical assistant in the laboratory of the Royal Institution. Mr. Gilbert Davies, who had himself detected the genius of Davy in the obscure home of a Cornish carver at Penzance, has said of the illustrious Davy, that the greatest of all his discoveries was the discovery of Faraday. In a few months after Faraday's installation at the Royal Institution, Davy started upon his prolonged visit to the Continent, and Faraday accompanied him as secretary and chemical assistant. His own modest merits were not altogether overshadowed by the shining fame of his companion, and he formed friendships in Paris, Geneva, and Italy which were only broken by death.

Faraday began his career of original investigation in 1816, with a successful analysis of a specimen of caustic lime from Tuscany. Since that time, his contributions to science flowed on in a steady stream, so broad and so deep that every province in Chemistry and Physics has felt the reviving influence. In Acoustics, we recall his researches on the sand-figures and lycopodium-heaps of vibrating plates, on musical flames and Trevelyan's experiment with a heated metal; in Optics, we are reminded of his papers on aerial perspective, on ocular deceptions produced by rotating wheels, on the relation of gold and other metals to light, on the borosilicate of lead or heavy glass, and of his services on the committee to which he was appointed in 1824, with Herschel and Dolland, by the Royal Society, to suggest improvements in the manufacture of glass for telescopes, and his valuable report upon the methods of manufacturing glass; in general and molecular Physics, we remember his labors and discoveries on the limit to evaporation, on the temperature of vapors, and their solidification, on their passage through capillary tubes, on the pneumatic paradox of Clement Desormes, on vegetation; in Practical Science, we are indebted to him for suggestions, experiments, inventions, or discoveries on ventilation, illumination, fumigation, gunnery, on india-rubber and the alloys of steel, on the prevention of explosions in collieries, on the extinguishment of blazing houses, on sustaining a prolonged breath in a dangerous atmosphere, and on the false pretensions of spirit-rappings and table-turnings.

This meagre enumeration, in which years of intellectual activity are registered in as many lines, indicates the exceeding great versatility of Faraday's genius. Nevertheless, Chemistry and Electricity were his favorite if not his absorbing pursuits, from the beginning to the end of the half-century which his discoveries have made so brilliant. And of these two Chemistry served him, but Electricity commanded him. It is impossible in this place to specify, much less to analyze, the varied researches of Faraday in chemistry and electricity.

In 1820 he described two new compounds of chlorine and carbon. "The discovery of these two compounds," says our Foreign Associate, De la Rive, "filled up an important gap in the history of chemistry." In 1825, Faraday discovered benzole, to which, says Hoffman, "we virtually owe our supply of aniline, with all its magnificent progeny of colors."

In 1820, Oersted set up one of those milestones which stand forever in the history of science, by his inauguration of electro-magnetism. Many pressed into the ranks to pursue the new discovery to its consequences, and Faraday among the foremost. He adapted the reaction between the current of electricity in the conductor and the magnet to the production of a continuous revolution, — a stupendous novelty then, without a parallel in mechanics nearer than the heavenly bodies. Even Ampere's sweeping generalization of the electro-dynamic action had not anticipated such a result, although it was afterwards able to explain it.

In 1831 the scientific interest which had been monopolized by electro-magnetism was transferred to a younger sister, magneto-electricity. Magneto-electricity was a corollary from Faraday's new discovery of voltaic induction, when the latter was viewed in the light of

Ampere's theory of magnetism. Science had been in possession of voltaic electricity for forty years, its most powerful instruments had been wielded by Davy, Hare, and Silliman, statical induction was a familiar fact; but it was reserved for Faraday first to see with his own eyes the external influence of current electricity. Henry's induced currents of the higher orders; Page's devices for exalting the intensity of induced currents, and their application to therapeutics; Ruhmkorff's coil, and its various adaptations to blasting, lighting, &c., — all these had their origin in Faraday's discovery of voltaic induction.

On the 20th of November, 1845, Faraday read to the Royal Society of London his startling discovery of the "Magnetization of Light and the Illumination of Magnetic Lines of Force." This discovery, from its delicacy and novelty, deserves to take rank as Faraday's greatest, standing, as Tyndall describes it, among his other discoveries and overtopping them all like the "Weisshorn among mountains, high, beautiful, and alone."

It really means, however, less than the language in which it was announced would convey to most minds. More than thirty years before, Seebeck and Brewster had succeeded in imparting to common glass, by pressure or heat, the depolarizing structure of crystals. It was reserved for Faraday to imitate, partially, the quartz-like structure of oil of turpentine, and its strange power of circular polarization, by subjecting his heavy glass, and even water, to the influence of strong magnets. This discovery was followed by others, in rapid succession, extending over a period of five years; all of which are included in his comprehensive classification of substances into Magnetics and Diamagnetics. A compass needle made out of a diamagnetic would point east and west, where an ordinary compass needle would point north and south. As oxygen is powerfully magnetic, Faraday labored hard to show that it was superfluous to seek for the cause of terrestrial magnetism, or at least of its fluctuations, outside of the earth's atmosphere. The antagonistic properties of magnetism and diamagnetism are influenced by crystallization. Faraday proved this for bismuth, antimony, and arsenic, as Plücker did for the optical axes of crystals. Faraday could have had little expectation in 1825, when he was melting the borosilicate of lead, that this heavy glass, which proved a failure for optical purposes, on account of its deep color, would, after standing on the shelf for thirty years, become the instrument of his grandest discovery.

Nor should we forget how much Faraday did to establish the identity of electricity, from whatever source it is derived, to prove the definiteness of its action, to unveil the process of electrolysis, to bring under one general law conduction and insulation, to assert the dependence of electrical and magnetic induction on the molecular agency of intervening media, and to deal a vigorous and mortal blow to the contact-theory of galvanism. Faraday was not destined, either by early associations, education, or mental constitution, to discuss successfully high themes of speculative philosophy or mathematical science, such as the nature and conservation of force, or the essence of matter, though he has written a few papers upon these subjects. Nevertheless, he contributed more largely, perhaps, than any of his contemporaries to that vast scientific capital, from which Grove has freely borrowed in the establishment of his theory of the Correlation of the Physical Forces, and the convertibility of one manifestation of force into another, as so many varieties of motion.

In 1854, as Faraday was approaching the close of his long period of active service, he delivered a lecture at the Royal Institution, under extraordinary circumstances, on Mental Education. This lecture deserves special commemoration, inasmuch as Faraday regarded the views expressed in it both as cause and consequence of his own experimental life. We here see that faith, humility, patience, labor of thought, mental discipline, well-educated senses, had all conspired to make him a fit high-priest of science. But he says that "this education has, for its first and its last step, humility."

After Faraday returned from his tour with Davy upon the Continent, he pursued the even tenor of his way at the laboratory of the Royal Institution with little interruption; not allowing himself to be distracted from the chosen work of his life by pleasure or profit or applause. Though by following out his researches to their practical application he might have amassed a large fortune, Faraday rejected the glittering bribe when it was already within his grasp, saying: "I felt I was not sent into the world for this purpose." If Faraday was sent into the world for the discovery of truth, then most certainly he accomplished his destiny. For was he not what Tyndall calls him, "the greatest experimental philosopher the world has ever seen"? Though Faraday would not desert his high vocation for emolument, he often did it at the call of his government, of humanity, of civilization, of science. Nothing could have been more distasteful to him than to leave, even for one hour, his quiet walk with Nature, which never cheated however she might elude him, and sit with table-movers and other pretended interpreters of her secrets. After describing the apparatus, which, with great experimental tact, he had devised for exposing the trickery or self-deception of his associates, he writes: "I am a little ashamed of it, for I think, in the present age, and in this part of the world, it ought not to have been required. Nevertheless, I hope it may be useful." And again he says: "I think the system of education that could leave the mental condition of the public body in the state in which this subject has found it must have been greatly deficient in some very important principle."

Many scientific men in Great Britain have surpassed Faraday in the clearness, elegance, and eloquence of their writings. But no one, unless it were Davy, possessed to such a degree Faraday's gift of imparting to others, in the lecture-room, what he had discovered for himself. If, as De la Rive said of him, he was never caught in a mistake in his laboratory, "the hand marvellously seconding the resolves of the brain," we may add that he seldom disheartened his audience by the miscarriage of an experiment, destroying the spell by which he had hitherto bound them. Though he was less dramatic, we might almost say less theatrical, in his style of address than Davy, he never failed to attract an admiring crowd, not only of the thoughtful and the educated, but of the gay and the high-born. He was equally at home with the juvenile audiences which listened to him during the Christmas holidays.

For fifty years, Davy and Faraday together have sustained the glory of the Royal Institution as with the brightness of a whole Academy; both of them of unchallenged greatness, not only as discoverers of physical truths, but as expositors also. In Davy was found a rare combination of poetry and science. Coleridge, it was said, frequented his lectures "to increase his stock of metaphors." Davy preferred the blazing battery of the Royal Institution to the chemist's balance. His generalizations were bold and dazzling. Quality, and not quantity, excited his mind. In ten years he stood on the pinnacle of fame. He was knighted; he was courted; and then his position at the Royal Institution was almost honorary. Faraday relied less on his imagination and more on his experiments. Brilliant as were his triumphs, they were won by hard work. His whole scientific life was one protracted campaign, — and that was a war of posts, and not a succession of brilliant charges. He prized the recognition of academies and universities, but not the insignia of rank. Without leisure for fashionable society, he enjoyed preaching to the humble sect of Christians to which he belonged as much as lecturing before princes and nobles, either of birth or of intellect, at the Royal Institution.

It is little to say of such a man that he was made a Fellow of the Royal Society of London in 1824, a Corresponding Member of the French Academy of Sciences in 1823, a Foreign Associate of this Academy in 1844; that his name was eagerly sought to adorn the list of honor of all other Academies in Europe and America; that he received from the Royal Society of London the Rumford, Copley, and Royal medals; that his simple life was made independent by a pension of £300, conferred upon him in 1835; that Napoleon the exile was instructed by his lectures, and Napoleon the Emperor acknowledged the obligation by naming him Commander of the Legion of Honor.

It is much to say of him that he declined all honors and rewards which were foreign to his scientific character; that, when he might have amassed a fortune of £150,000 by applying old discoveries to commercial uses, he preferred to concentrate his whole mind on the discovery of new truth, dying poor, and leaving a widow dependent on a small pension, which, in noble imitation of his example, she refused to have increased; that he ruled a strong nature so as to be always gentle, and only impatient of those who unnecessarily wasted his time; that he was as much exalted above others in modesty as in intellectual greatness; that he made science honorable and attractive; that he ruled with an imperial sway the hearts no less than the intellects of his generation, and that his final departure from the laboratory in the Royal Institution of Great Britain on the 20th of June, 1862, was followed by one universal pang of grief throughout the world of science.

Long and loudly and perseveringly had Faraday knocked at the secret gates of nature, and most encouraging were the responses which, from time to time, he had received. Nevertheless, he finds it in his heart to say: "I have never seen anything incompatible between those things of man which can be known by the spirit of man which is within him and those higher things concerning his future which he cannot know by that spirit."

Faraday, with a wise precaution, which consulted the convenience of others no less than his own reputation, made a timely collection of his scattered publications, and placed them in a compact and permanent form, suited to the private library of the student of science. His "Series of Experimental Researches upon Electricity" amounted to thirty; all but one of which are now contained in three volumes, published successively in 1839, 1844, and 1855. These Researches are illustrated by other papers upon the same subject, originally printed in the Philosophical Magazine, or in the Journal and Proceedings of the Royal Institution, as the Researches themselves were in the Philosophical Transactions. Faraday's "Experimental Researches in Chemistry and Physics" fill a fourth volume which appeared in 1859. Also, under his sanction and partly from his notes, have been printed, "Six Lectures on the Non-metallic Elements," in 1852; "Six Lectures on the various Forces of Matter," in 1860; and "Six Lectures on the History of a Candle," in 1861.

The first edition of the "Chemical Manipulation" bears the date of 1827. This was followed by an American edition in 1831, and a second English edition in 1842.

Sir David Brewster was born, December 11, 1781, at Jedburgh, Scotland, also the birthplace of the accomplished commentator upon Laplace's *Mécanique Céleste,* Mary Somerville. He died at Allerly House, Melrose, in Scotland, February 10, 1868. Although he had reached his eighty-seventh year, we are assured, in the circular announcing his death, that "his faculties were unimpaired to the very last, and he died in the full assurance of faith in Christ Jesus."

What revolutions in old sciences, what brilliant careers of new sciences, are condensed into this single lifetime? Born before Galvanism was even a name, he lived to see Voltaic Electricity give birth to the twin sciences of Electro-Magnetism and Magneto-Electricity, throw off its own ephemeral character in the sustaining batteries of Grove and Bunsen, and close a long catalogue of practical triumphs in chemistry, physics, and mechanics with the oceanic telegraph. Born before Chladni had revived experimental acoustics or published *Die Akustik,* he lived to see this beautiful branch of Physics expand under the cultivation of Savart, Cagniard-de-la-Tour, Wheatstone, Faraday, Lissejous, and Helmholtz, until, by affiliations more startling than any which Mrs. Somerville celebrates in her "Connection of the Physical Sciences," the eye threatens to supplant the ear in the investigation of the laws of sound, quality appears to be resolved into quantity, the vowel sounds are mocked by an orchestra of tuning-forks, and

Brewster's own prediction has the promise of fulfilment,—"I have no doubt that, before another century is completed, a talking and a singing machine will be numbered among the conquests of science." Born at a time when the corpuscular theory of light compelled assent, from the influence of Newton's great name, when Laplace would not tolerate any discussion of the opposing theory in the French Academy of Science, when Lord Brougham fiercely attacked what he afterwards cordially espoused, he lived to witness the complete triumph of the undulatory theory in the hands of Young and Fresnel, and to see what Lloyd has called "a mob of hypotheses" exchanged for what Herschel characterizes as "one succession of felicities." Though neither himself nor Biot ever deserted the lost cause, of which they were the bold experimental champions, Brewster, in his Report on Optics, prepared for the British Association for the Advancement of Science, has done ample justice to the labors of Malus and others who contributed to its overthrow; and he congratulates mankind that "even amid the convulsions and atrocities of that awful period Science shot forth some of her brightest radiations, and, in the moral and religious darkness which prevailed, her evening star was the only surviving emblem of heaven."

Of nearly one hundred papers which Brewster published in scientific journals or in the transactions of academies, there are very few which do not touch his favorite subject, viz., Optics. Optical instruments; polarization, rectilinear, circular, and elliptical; depolarization; the optical character of crystals, and the mode of producing crystalline structure artificially; vision, both subjective and objective; the action of the eye in man and other animals; the interference, dispersion, and absorption of light; the spectral lines in sunlight, as produced by the sun's atmosphere, or the earth's atmosphere, and as multiplied by other absorbing media;—this was the burden of his long life of research and of his voluminous writings.

Born seven years after Biot, Brewster died about seven years later, so that the long and laborious lives of these two eminent physicists went hand in hand for more than half a century. If Brewster did not share the great mathematical powers of Biot, if he was without the genius for vast and rapid generalization displayed by Fresnel in optics and by Ampere in electro-magnetism, nevertheless he was endowed with consummate skill in experiment, and deduced empirical laws where Malus and Arago had failed. We may adopt the language of Professor J. D. Forbes, and say: "His scientific glory is different in kind from that of Young and Fresnel; but the discoverer of the law of polarization, of biaxial crystals, of optical mineralogy, and of double refraction by compression, will always occupy a foremost rank in the intellectual history of the age." His theory of only three primary colors, which he proposed as a substitute for the seven primary colors of Newton, though plausible and well sustained by his experiments, has suffered more from neglect than from criticism, Helmholtz alone having seriously undertaken to refute it. Outside of the range of Optics, Brewster's most important contribution to science was a paper, published in 1821, on the mean temperature of the globe and the close coincidence between the poles of maximum cold and maximum magnetic dip. His first appearance, in 1806, before the commonwealth of science, was with a criticism upon the demonstrations of the lever, as furnished by Galileo, Huyghens, De la Hire, Newton, Maclaurin, Landen, and Hamilton. The solution which he himself gives of this fundamental problem in statics, if not unexceptionable, is certainly ingenious, and indicates a mind well adapted for mechanical research.

Brewster's scientific labors sometimes assumed a practical turn. In 1831 he published, in the Transactions of the Royal Society of Edinburgh, a memoir on the construction of Polyzonal Lenses for Lighthouses. As early as 1748, Buffon had proposed a similar device for burning-glasses. The execution of it was postponed for thirty years, and then proved a failure even in the hands of Rochon. Condorcet, in his eulogy upon Buffon, pronounced in 1788, suggested a modification of his plan, which consisted in building the lens up of separate rings. We next hear of the subject from Brewster in 1811. But the British government were not ready to take the hint from their scientific advisers until after Fresnel had presented to the French Academy of Sciences, in 1822, his memoir on Lighthouses, and his lamp and lens shot forth a blaze of light from the headlands of France.

The Kaleidoscope, which Brewster invented in 1817, delighted and instructed all Europe at the time. Fashion may have dethroned it, though once the ornament of the fair sex: but it has not outgrown its popularity in the nursery, and time never can exhaust the fertility of this invention in devising patterns for the manufactory. No less wonderful, no less charming, is the Stereoscope, which, though invented by Wheatstone, has been remodelled by Brewster in a way which has brought it into the homes of millions, to delight, refine, and civilize all ages and all classes.

The literary labors of Brewster lose their importance, only in comparison with his scientific discoveries. In 1807, Brewster became editor of the "Edinburgh Encyclopædia," which he dedicated to his college friend, Lord Brougham. To write what he did for it himself, and marshal into order the other one hundred and fifty contributors to its eighteen volumes, was his principal occupation for twenty years of his life. Between the years 1819 and 1824 he edited, with Professor Jameson, ten volumes of the "Edinburgh Philosophical Journal"; between the years 1824 and 1829 he edited, single-handed, ten volumes of the "Edinburgh Journal of Science." From 1832 to the time of his death he was one of the editors of the "London and Edinburgh Philosophical Magazine and Journal of Science." In 1811 he edited a new edition of Ferguson's Astronomy, and in 1837 he published a Treatise on Magnetism, which he had written for the seventh edition of the Encyclopædia Britannica. Add to these labors his little work on the Stereoscope, and the two editions of another little work on the Kaleidoscope, his Treatise on New Philosophical Instruments, a Treatise on the Microscope, a volume on Optics which was published in Lardner's Cyclopædia, his Letters on Natural Magic, his Martyrs of Science, his Essay on the Plurality of Worlds, his Life of Sir Isaac Newton, published in the Family Library, to say nothing of his numerous contributions to the Edinburgh Quarterly and North British Reviews, and the wonder is that he found any leisure for his scientific pursuits.

The reflections cast upon Newton by the astronomer Baily, in his Life of Flamsteed, reanimated the spirit of Brewster, never too ready to succumb to his antagonists. He obtained valuable manuscript materials from Lord Portsmouth, brooded over the subject for more than twenty years, and in 1855 published a greatly enlarged work, in two volumes, under the new title of "Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton." Of which a critic, none too friendly, in the London Athenæum, has said: "This work, with all its faults, is a noble monument to Newton's memory and a pillar of fame to the writer." And in the recent struggle to divide with Pascal the honors of the discoverer of universal gravitation, who can doubt which side Brewster took, or be surprised that the venerable survivor of many hard-fought battles entered into the conflict with all the vigor of youth?

The title of one of Brewster's recent publications, "More Worlds than One, the Creed of the Philosopher and the Hope of the Christian," is characteristic of his general tone of thought and argument, and reminds us that he was originally destined for the Christian ministry, and had been licensed to preach in the Church of Scotland. At the University of Edinburgh, from which he received the honorary degree of A. M. in 1800, he enjoyed the valuable instruction and friendship of John Robison, John Playfair, and Dugald Stewart. In 1799, at the instance of his intimate friend, afterwards Lord Brougham, he studied Newton's investigations on the Inflection of Light, and repeated his experiments. But the discovery by Malus, in 1808, of the Polarization of Light fired him with new ardor in the pursuit of physical optics, and determined his future career. In 1815, during Professor Playfair's visit to the Continent, Brewster took his place in the University as Lecturer upon Natural Philosophy.

A literary and scientific career, so long, so laborious, so useful as that of Brewster, deserved the gratitude of his contemporaries, and he enjoyed it both at home and abroad. He received the degree of LL. D. from the University of Aberdeen, that of D. C. L. from Oxford, and that of A. M. from Cambridge. In 1808 he was chosen a member of the Royal Society of Edinburgh; and was its President from 1864 to the time of his death. In 1815 he was elected a Fellow of the Royal Society of London, and received from it the Copley Medal for his paper on the Polarization of Light by Reflection. In 1818 he won the Rumford Medal by his Discoveries relating to the Polarization of Light. In 1816 a prize was divided by the Institute of France between Brewster and Seebeck for their researches on the depolarizing structure of heated and compressed glass.

In 1825, Brewster was made a Corresponding Member of the Institute of France, and in 1849 he attained the high distinction of being chosen to succeed Berzelius as one of the eight Associate Members of the Academy of Sciences. He was called to preside at the twentieth meeting of the British Association for the Advancement of Science, held at Edinburgh in 1850. With honor to himself, and advantage to his country, he filled, in succession, the two highest literary positions in Scotland, being first Principal of the old University of St. Andrews, and afterwards, in 1859, Principal of the University of Edinburgh.

Since his death, a pension of £200 a year has been granted by the government to Lady Brewster, and soon a statue to the memory of her husband will stand in the city of Edinburgh.

Thus honored and trusted, lived, and labored, and died Sir David Brewster; a careful experimentalist, an elegant writer, a warm advocate of what he believed to be the truth. In him Christian faith was instructed by accurate science, and science was illuminated and inspired by Christian faith.

SIR WILLIAM LAWRENCE, an Honorary Member of the Academy, died on the 5th of July, 1867, aged 84. He was born at Cirencister, near Gloucester, England, in 1783, and was educated at the Classical School. In his seventeenth year he went to reside in the family of Mr. Abernethy, to whom he was apprenticed. His official connection with various hospitals began in 1801, when he was appointed Demonstrator of Anatomy at St. Bartholomew's. In 1828, having steadily advanced in reputation and honors, he succeeded Mr. Abernethy as Lecturer on Surgery in that Hospital. In 1814 he was elected Surgeon to the Eye Infirmary, and in 1815 Surgeon to the Royal Hospitals of Bridewell and Bethlem.

In 1865, having been in constant service in these institutions for more than sixty years, he resigned at the age of eighty-two.

Mr. Lawrence was Fellow of the Royal Society and Vice-President during the Presidency of the Duke of Sussex. He was a member of the French Institute, and of other learned and scientific associations. In 1831 he was elected President of the "Medico-Chirurgical Society," and, in 1858, Surgeon to the Queen.

It is unnecessary on this occasion to enumerate the long list of his works; suffice it to say that from the year 1801 he was constantly engaged in literary labors either in the form of contributions to various journals or of elaborate treatises. His translation of Blumenbach, with the addition of numerous notes and an introductory view of the classification of animals on the basis of anatomical structure, was published in 1807, and gave the first impulse, in England, to the study of comparative anatomy. He also contributed the anatomical and physiological articles in Rees's Cyclopædia. In 1819 appeared the "Lectures on the Physiology, Zoölogy, and Natural History of Man." In this department, in England, there had previously been very little investigation, and this work excited great interest. It displays a vast amount of research and knowledge, and is eminent authority at the present day. Of the strictly professional works, the most important are the treatises on Diseases of the Eye, on Hernia, and his most recent work on Surgery.

The Treatise on Diseases of the Eye, comprising his own opinions and those of men distinguished in that department, is a learned and comprehensive exposition of the science of that period. The Treatise on Hernia, probably the most important of his works, was first published in 1806. It has passed through many editions, which were enriched by extensive observations in St. Bartholomew's Hospital. The name of Mr. Lawrence will be always identified with the progress of Surgical Science, and the treatise on this subject will remain a monument to his learning and industry.

The late Sir Benjamin Brodie remarks that he "never knew one who had a greater amount of information, not merely on matters relating to his profession, but on a great variety of other subjects."

"His personal appearance was striking and impressive; he had a tall, manly figure, and his head and features were models of intellectual beauty and power."

His learning, eloquence, and genial disposition made his fireside most attractive. He often expressed his admiration of our free institutions, and many Americans will remember his generous, self-sacrificing hospitality.

PIERRE FRANÇOIS OLIVE RAYER was born, March 7, 1793, of a respectable Bourgeois family, at Saint Sylvain, near Caen, France. After the necessary preliminary education, he commenced the study of medicine, and was graduated Doctor of Medicine, at the age of twenty-three, in Paris. He was a student and favorite pupil of M. Duméril. Among his contemporaries were Dupuytren, Corvisart, Velpeau, Louis, Larrey, Trousseau and others, who have made the present century such a brilliant epoch in the history of French medicine. He was doubtless stimulated by their example and labors to constant effort in his chosen career, but they owed as much to him as he to them.

Through persistent labor and conspicuous merit, he attained successively the highest professional and scientific positions. In 1825 he was appointed to the medical staff of the Hospital of Saint Antoine. In 1832 he was transferred to the Hospital of La Charité. He was selected by Louis Philippe as one of the consulting physicians of the Royal household; and in 1852 he was taken by the Emperor Napoleon into the medical service of the Imperial family. Rapidly winning the confidence of the community, he soon became known as one of the largest practitioners of medicine in Paris. He was elected into the Academy of Medicine in 1823; and in 1843 he became a member of the Academy of Sciences as the successor of M. Morel Vincté. In 1862 he was appointed to fill the newly created chair of Comparative Medicine, and about the same time was chosen Dean of the Medical Faculty of the University of Paris. He was President of the Central Committee of Public Hygiene, and also of the General Association of the physicians of France. In 1855 he was elected an Honorary Member of this Academy. Among the various marks of honor which the Emperor conferred upon him was that of Commander, and, when he resigned the place of Dean of the Faculty of Medicine, that of Grand Officer of the Legion of Honor. In connection with Bernard, Robin, Lebert, and one of our own associates, C. E. Brown-Séquard, he was one of the founders of the Society of Biology, — a society which has probably contributed of late years more than any other to a just and comprehensive study of life in all its manifestations. He was the animating spirit of this Society, and was most properly made its perpetual President.

But it is not the honors with which he was crowned, or the responsible posts which he filled, or the elevated social position to which he attained, that entitle M. Rayer to our especial regard. His best monument is to be found in his published works. Soon after his graduation he published a brief Summary of Pathological Anatomy. This was followed in a short time by memoirs on a variety of medical subjects, such as a note on the Coryza of Nursing Infants; a monograph on Delirium Tremens; a History of the Epidemic of Miliary Sweat, which prevailed in the Departments of Oise, and of the Seine and Oise, in 1821; and a number of smaller treatises. In 1835 he put forth a more elaborate work than any of the above memoirs. It was entitled "A Theoretical and Practical Treatise on Diseases of the Skin, founded on Original Anatomical and Pathological Researches." This was in two volumes, and was accompanied with an atlas of colored plates. The value of the work was attested by the appearance, in a short time, of a second edition, which was enlarged to three volumes, with a corresponding addition to the atlas of illustrations. At the time of its appearance, this work was a most important addition to Dermatology, and prepared the way for the minute and careful studies of later observers.

The function and diseases of the kidneys early attracted the attention of M. Rayer. The result of his studies in this direction appeared in what was the capital work of his life, and which he called, "A

Treatise on Diseases of the Kidneys, and their Relations to Diseases of the Bladder, the Prostate, and the Urethra." This was completed in three volumes, and was illustrated by a folio atlas of sixty colored plates. As soon as it appeared, it was received as the foremost book of its kind. It was acknowledged as an authority in this country and in England. Two separate translations of it into the German language proved the value which German observers set upon it. Aided by the microscope and the laboratory, later physiologists have gained a more accurate knowledge of the pathology and physiology of the kidneys than can be gathered from M. Rayer's work; but this does not detract from its value. It was a great addition to medical science.

Besides these labors, M. Rayer found time to investigate a department of pathology that before him was almost unknown, or at least unexplored, namely, that of Comparative Medicine. The chair of that name, which was established by the Medical Faculty of Paris in 1862, was immediately offered to him as the person best qualified to fill it. His monograph on glanders and farcy in the human subject is unique of its kind. The extent of his general knowledge of medicine is shown by the fact of his being one of the authors of the "Dictionary of Practical Medicine," a sort of medical encyclopædia in fifteen volumes. He was, moreover, a frequent contributor to various scientific journals, such as "Les Archives de Médecine Comparée"; "Les Mémoires de l'Académie des Sciences"; "Le Nouveau Journal de Médecine," etc.

It was said of M. Rayer, by one of his contemporaries, that "he was not only distinguished by the works which he produced, but by those which he inspired." The number of eminent men whose early studies he directed and encouraged, and whose fortunes he sometimes aided in most substantial ways, confirms the truth of this remark. Like Stahl and Boerhaave, he loved to surround himself with a group of youthful *savans*, whom he animated and guided. Claude Bernard, the ingenious and sagacious observer, who has contributed so largely to the advancement of physiology; Robin, who has justly been called the creator of French histology; and Littre, whose translation of Hippocrates and whose knowledge of historical medicine has earned for him so wide a renown, — all were encouraged, substantially aided, and often guided in their earlier and later studies by M. Rayer.

As a practitioner, he was one of the most successful of the French physicians. It was said of him that he was first among scientific physicians and also first among medical practitioners. His acquaintance with the works and original papers of the physiologists of the present century made him an acknowledged authority on physiological questions. Honest and frank in the expression of his views, when he had occasion to present them, he possessed the rare virtue of being able and willing to recognize and acknowledge an erroneous opinion of his own, whenever the error could be demonstrated. When we consider the extent and variety of his labors, — his private practice, his hospital attendance, his collegiate teaching, and his published writings, — we are surprised that one man could have found time to accomplish so much and so well.

M. Rayer died in Paris, September 10, 1867, at the age of seventy-four years and six months. The appreciation in which his services to science and medicine were held by his contemporaries was abundantly evinced by the numerous eulogies that were pronounced at the time of his death.

Franz Bopp, Professor of Sanskrit and of Comparative Philology in the University at Berlin, died on the 23d of October last, at the advanced age of seventy-six years. Among the philologists of the present century he was perhaps the foremost. Others of his contemporaries, especially of his countrymen, have shown not less remarkable talent, reached as high a degree of scholarship, and won an equal distinction, in various departments of the study of languages and literatures; but to him belongs the peculiar and transcendent honor of having inaugurated and given development to a new science, — that of the historical investigation of human speech. It is an honor of which he can be in no measure deprived; even though it be shown that some of his discoveries had been partially anticipated by others, or, on the other hand, that the times were ripe for the appearance of such a science, which must have sprung up and gained a rapid growth without him. For, as a matter of fact, it was he who turned to profitable account the scattered and imperfect perceptions of others, who improved and made fruitful their methods of research, who took advantage of the favorable conditions of the times, and with steady devotion, clear insight, and admirable skill, laid a foundation and reared a structure which others may indeed improve and extend, but can never destroy.

Bopp was born at Mayence, in Bavaria, on the 14th of September, 1791, and received his early education at Aschaffenburg, where the influence especially of Windischmann directed his attention to Oriental studies. At the age of twenty-one he went to Paris, drawn thither by the attraction of the collections of Oriental manuscripts in the great library. Paris was then incontestably the centre of Oriental study for Europe; even a little school of Sanskrit philology had arisen there, having for its first teacher Alexander Hamilton, an English East-Indian, one of Napoleon's prisoners after the breach of the peace of Amiens. To the study of the Sanskrit, and to the comparison of Indo-European languages to which it so naturally led, Bopp soon began especially to devote himself, — a devotion which he was never to relax until stricken down by his last illness. More than any other person, he aided to make the Sanskrit accessible to European scholars, by a series of grammars, texts, and glossaries, which, though they have their defects, are even now among the most valuable parts of the apparatus of study within reach of the learner. With him, however, the Sanskrit was the thing of subordinate consequence, the handmaid of comparative philology; into the history, antiquities, and literature of India he never cared to penetrate very far, nor did he strive to become a profound Sanskrit scholar, to master all the niceties of its structure and usages. Even before leaving Paris for a further season of study in England, he prepared and published, in 1816, the forerunner of his great Comparative Grammar, a little volume entitled "The Conjugation-System of the Sanskrit Language, in comparison with that of the Greek, the Latin, the Persian, and the German Languages." In this he sketches the principal features of his whole system, as afterwards developed. He assumes as demonstrated the truth, pointed out by many before him, of the relationship of the Sanskrit with the other tongues named, not as their mother, but as their older sister, but in the use he makes of this truth he had no predecessor; he would fain derive from their comparison their history and the genesis of their words and forms. He takes up their grammatical mechanism as an object in itself worthy of study, and sure to lead, when comprehended, to valuable results for other departments of knowledge. Both in his distinct apprehension of the work to be done, and in the clearness, good sense, and acuteness of the methods of research he devised and employed, in the geniality and fruitfulness of his whole mode of labor, he so far surpassed all who had gone before him, and furnished an example and model for those who should come after him, as to become the founder of the science. It is, then, not without reason, that the fiftieth anniversary of the date affixed to the preface of the "Conjugation-System" was celebrated just two years ago (May 16, 1868) in Berlin, as the jubilee of Comparative

Philology, by the establishment of a Bopp fund, of which the income should be forever devoted to the encouragement and aid of researches in this department of knowledge. The endowment, amounting to over ten thousand thalers, was made up by the contributions of scholars and friends of learning in all parts of the world, — those of our own country, among the rest, furnishing their mite to swell the sum.

On his return to his native country, Bopp was nominated by the Bavarian government to a professorship in the University of Würzburg; but the handful of pedants who composed the senate of that institution resolved that the studies which he represented had no claim to a place in it, and respectfully declined to ratify the appointment. But the next year (1821) he was called to a vastly higher and wider sphere of labor in the Berlin University, in connection with which and with the Academy of Sciences of the same city his chief literary activity was henceforth exercised.

The most important of his works, by far, is his Comparative Grammar, of which the first edition began to appear in 1833 and reached its completion in 1849. A second edition, in three volumes, considerably modified and extended, was commenced in 1857 and finished in 1861. The former was long since translated into English; of the latter, M. Bréal is now putting forth a French version. Into any extended description or criticism of this great work we are not called upon to enter. It is a rich mine of observations and conclusions, the compendium of what was done for the new science by its founder. We must not regard it, however, as in all parts of equal merit and authority. Bopp lived long enough to see his science carried further, in many points, by his followers than by himself. At the same time, he was not one who readily assimilated the results won by others. The later years of his life were comparatively unfruitful of valuable additions to science; and when at length he passed away, it was rather the presence of the man than the work of the scholar that was missed by us.

August Boeckh, the illustrious philologist, long a member of the Academy, died in Berlin, August 3, 1867, aged 82. He was born in Karlsruhe, November 24, 1785, and had the misfortune to be left an orphan at the age of three. From his sixth to his eighteenth year he attended the gymnasium at Karlsruhe, where he went through an unusually thorough course of study for the times, embracing the classics, mathematics and physics, and philosophy.

Thus prepared for a more independent course of study, Boeckh left

Karlsruhe in 1803 for the University of Halle, to which he was drawn by the great reputation of Friedrich August Wolf. His original intention was to study theology and philology together. But his interest in the latter study soon led him to discard theology and to devote himself to philology as his professional study, combining, however, with it philosophy under Schleiermacher, — a combination that gave a turn to his first literary undertaking on the Minos and the Laws of Plato.

On leaving Halle in 1806, Boeckh began as a teacher in Berlin. But the fortunes of the war then raging soon forced him to leave Prussia and go to Heidelberg. His rapid academic advancement is an evidence of the precocity of his genius. He was appointed Extraordinary Professor at Heidelberg in 1807, Ordinary Professor in 1809, and in 1811, when the University of Berlin was founded, he received a call as Professor of Eloquence and Ancient Literature.

From 1811 to 1867 — fifty-six years — he lived in Berlin the uneventful life of a scholar, dividing his time between study, his duties as Professor and head of the Philological Seminary, and various other charges for which his extraordinary aptitude for affairs fitted him. He was repeatedly Rector of the University. In the sessions of the Academy he took a lively interest, and his communications to that body have become a standard part of philological literature.

Both in his elaborate books and in the more fugitive pieces and courses of lectures which laid the groundwork to these books, Boeckh exhibited two qualities not often united, — a faculty for details and a comprehensive grasp of the general subject. He had a perfect genius for details. No matter what the subject was that interested him, — and in his long and manifold studies there were few things connected with ancient life which did not interest him, — whether it was a question of weights and measures, of finance, of grammar, of metres, of orthography, or astronomy, — he followed the thing out with a microscopic eye into its minutest ramifications, weighing carefully all the evidences of the text and studying the credibility of his witnesses. In his earlier years he kept copious notes and *adversaria*. Later in life he gave them up, trusting entirely to his memory. Under such a load of erudition a less happily balanced mind would have staggered and stumbled. But in combination and arrangement Boeckh was equally at home. With the insight of genius he looked at the tangled and complicated masses, and order sprang out of chaos. Grasping the leading idea, he carried it out consistently to the end, and his intimate familiarity with the whole range of ancient thought and action enabled him to shed a flood of light on all the parts.

To enumerate the works of Boeckh would take us far beyond the bounds of this brief notice. As Professor of Poetry and Ancient Literature, the representative and spokesman of the University, he was officially bound to deliver orations on public occasions and to write the University programmes. The collection of Orations and Dissertations published in three volumes from 1858 to 1866 gives but little idea of his gigantic industry. Of his larger books we need hardly name his Pindar, his Collection of Greek Inscriptions, and his Public Economy of Athens.

While Boeckh was known to foreign countries by his works, at home he exerted an influence equally great by his personal teachings. In his younger days he lived in intimate relations with his pupils, quite carrying out the old academic idea of Master and Disciples, now among the traditions of the past. As the University grew and his own audiences became larger, this was no longer possible, and his connection with the younger generation was confined to his labors in the Seminary and his Lectures. The Lectures, which were partly exegetical and partly systematic, — among the latter the courses on Antiquities and on the Encyclopædia of Philology being particularly prized, — were marked by the same minuteness of detail and the same general grasp which characterized his books. His style and delivery were plain and to the point, giving an impression of immense shrewdness and reserve power, and the earnestness of his discourse was every now and then lighted up by a flash of homely drollery.

Grown old among his books, he celebrated the sixtieth anniversary of his Doctorate, March 15, 1867, and received such an ovation from scholars, citizens, and crowned heads as is never given to a scholar out of Germany and seldom equalled there. Shortly after, he died.

KARL JOSEPH ANTON MITTERMAIER, born at Munich, August 5, 1787, died at Heidelberg, August 28, 1867, at the age of eighty, after a life of zealous, honorable, and learned labor in the cause of science and humanity. In 1819 he became a Professor of Law at Bonn, whence, in 1834, he was transferred to Heidelberg. In 1859 he celebrated his professional jubilee. For more than half a century he was well known as a teacher and writer on subjects of great interest in civil and criminal law. His learning was not absorbed in the past, but put to constant service in behalf of the present and the future. In this best sense he was a reformer. As a public man at times in middle life, he held the position of a moderate liberal, and distinguished himself in furthering reformatory and progressive legislation. He favored oral and public procedure in the civil courts, the separation of judicial from administrative functions, and the abolition of corporal punishment as a means of eliciting the truth; and he pronounced himself a friend to the freedom of the press. But his public life terminated almost twenty years before his death. As an author, he is widely, though by no means exclusively, known as a criminalist. And he was remarkable for the assiduity and activity with which, by reading, correspondence, and travels, he made himself contemporary with whatever in criminal and penal legislation and procedure was going forward in different countries. In this department of comparative law he was an adept and a leader. The extent of his researches furnished a basis for general conclusions, and his liberal spirit turned them readily into the path of reform. In 1851 he published an important work on criminal procedure in England, Scotland, and North America. Some months before his death this treatise appeared in a French translation, enriched with the copious fruits of the author's study and personal observation in the interval. In 1865, at the age of seventy-seven, he put out a work (since translated into several languages) in which, surrendering his early opinion on capital punishment, he declared himself in favor of its total abolition. The enlargement of this work by the results of indefatigable inquiries in Europe and the United States was prevented only by his death. These unpublished collections have been deposited in the library of the University of Heidelberg.

Since the last annual meeting the Academy has received an accession of eleven new members, as appears in the following list.

Of Resident Fellows there have been elected, —

Dr. Charles E. Brown-Séquard in Class II., Section 3.
Com. John Rodgers, U. S. N., in Class I., Section 4.
Edward C. Pickering in Class I., Section 3.
James M. Crafts in Class I., Section 3.

Of Associate Fellows, —

Rowland G. Hazard in Class III., Section 3.
Dr. J. Lawrence Smith in Class I., Section 3.
Hon. Horace Binney in Class III., Section 1.
Hon. Daniel Lord in Class III., Section 1.

Of Foreign Honorary Members we have elected, —

Major-General Edward Sabine, in place of Admiral Duperrey, in Class II., Section 1.

M. Chevreul in Class I., Section 3.

One of our members, Dr. C. H. F. Peters, has been transferred from the list of Resident Fellows to that of Associate Fellows in Class I., Section 2.

Five hundred and ninety-seventh Meeting.

June 23, 1868. — ADJOURNED ANNUAL MEETING.

The PRESIDENT in the chair.

The memoirs of the Foreign Honorary Members deceased during the year were read from the Council's Annual Report by the Corresponding Secretary and Professor Lovering.

Nominations by the Council were read.

The Statute Meeting for August was adjourned to the second Tuesday in September, and a Special Meeting was appointed for the first Tuesday in July.

Five hundred and ninety-eighth Meeting.

July 7, 1868. — SPECIAL MEETING.

The PRESIDENT in the chair.

The President called the attention of the Academy to a circular letter announcing the celebration at Berlin of the fiftieth anniversary of Ehrenberg's Doctorate.

On the motion of Dr. Bowditch the following vote was passed: —

"Resolved that this Academy desires to express their sincere congratulations to Dr. Ehrenberg for his long and honorable services in the cause of science, and requests their President, Dr. Asa Gray, and Professor Joseph Lovering, to represent them on this interesting occasion."

Professor Lovering made a communication on the application of Electricity to maintaining the vibrations of a tuning-fork, and of the tuning-fork to exciting and sustaining the vibration of threads or cords.

The elements which comprise the essential features of the machine, now exhibited, are not original. The application of electricity as the maintaining power for such rapid vibrations as belong to tuning-forks is not new, though it is of recent discovery; and the application of tuning-forks to exciting sympathetic vibrations in cords is not new, though it is also of recent discovery. I am not aware, however, that these two discoveries have been united into one, by employing a tuning-fork, *so impelled*, for this particular purpose. Such tuning-forks have already been made and used by Koenig for producing the Lissejous' curves, and for exhibiting the phenomena of interference of sounds; and this new application, therefore, is sufficiently obvious, and may have been already anticipated by other physicists. The tuning-forks in *ut*, etc., manufactured by Koenig for repeating Melde's experiments on the vibrations of cords, are only adapted to short threads of saddler's silk. My object has been to provide a tuning-fork which would not be overloaded with a stout cord of thirty or forty feet in length.

The prongs of my tuning-fork are thirty inches in length, two inches in width, and three eighths of an inch in thickness; and, in spite of the encumbrance of the cord, they will vibrate for many minutes without the aid of electricity, making excursions of one half of an inch on each side of the position of equilibrium. The outer face of each prong, when at rest, is exposed to one pole of an electro-magnet, at the distance of three fourths of an inch from it. The iron core of this electro-magnet has a circular section of an inch and one fourth in diameter, and is wound with copper wire to the depth of two inches.

The extremities of this iron core carry nearly cubical blocks of soft iron, of about one inch and a half in linear dimension, through which are screwed pieces of iron of one half of an inch in thickness. The ends of these pieces are the acting poles, and are screwed through the blocks, in order to adjust the distance between the poles of the magnet and the prongs of the tuning-fork. With four cups of Bunsen's battery, the zincs of which are cylinders, four inches in diameter and seven inches in height, and connected for *intensity*, the magnet has strength sufficient to initiate the motion of the prongs, at the distance even of three fourths of an inch, and to bring them soon into energetic vibration. The current of electricity runs through the stem of the tuning-fork into the lower prong, near the extremity of which, and upon the interior surface, is a small platinum plate which is touched by the point of a platinum wire. This platinum wire is attached to the end of a short spring. When the current begins to flow, the prongs of the tuning-fork are attracted outwards, the platinum plate is withdrawn from the platinum wire, the flow of the electrical current is interrupted, and the prongs of the tuning-fork are free to spring together again, without the retarding influence of the magnetic poles. The tuning-fork itself, therefore, interrupts the current at each of its vibrations, so as to be subject to an accelerating force of magnetism, when its prongs are moving *outwardly*, without a corresponding retarding action, when they are moving *inwardly*.

The vibrations of this tuning-fork are so energetic, and the amplitude of its excursions is so large, that the ends of the prongs often strike the poles of the electro-magnet. The tuning-fork easily commands the motion of a stout cord, thirty or forty feet in length, which vibrates as a whole, or in segments, whenever the tension is such as to make any one of the harmonics of the cord correspond to the note of the tuning-fork. The middle of the segments sweeps through a breadth of two or three inches, and the eye easily recognizes the nodes, and other peculiarities of vibrating cords, even when the rate of vibration is too slow to produce any acoustic effect. In this way, all the laws of vibrating strings may be illustrated to the coarsest eye even more satisfactorily than is possible with the most highly educated ear."

Five hundred and ninety-ninth Meeting.

September 8, 1868. — ADJOURNED STATUTE MEETING.

The RECORDING SECRETARY in the chair.

Professor Lovering made the following communication on the Periodicity of the Aurora Borealis: —

As this paper will appear in full in the Memoirs of the Academy, over three hundred pages of which are already printed, only a brief abstract will be given in this place. I was incited to the study of the laws of periodicity of the aurora by the absence of any recorded appearances of this display, in this country, before the early part of the eighteenth century, — a failure in the record which could not easily be explained except by a failure in the phenomenon itself, especially when it is considered that the early settlers of New England were not likely to have overlooked appearances which they could so readily associate with the religious or political events of their heaven-determined destiny. A preliminary discussion of the subject was first published in the American Almanac for 1860, and afterwards, with some modification, in the Memoirs of the Academy, Vol. IX. p. 101. But I was soon satisfied that no satisfactory solution of a vast problem could be reached, which was built on anything less than the richest materials that could be gathered from the records of science. Much time has been expended, therefore, in preparing and printing a complete catalogue of all the auroras observed from the earliest times down to the present year, — a catalogue which comprises about ten thousand independent auroras and fifty thousand observations.

The discussion of these materials, so far as it has yet progressed, relates especially to the distribution of auroras between the different days and months of the year, and the accuracy with which this distribution may be expressed by a periodical function. The subject is considered, not only for the whole earth, but also separately for the two hemispheres, and for each place where a series of observations has continued long enough to justify a distinct discussion. The number of auroras occurring in different seasons of the year has been computed by the following formula: —

$$N = A + C_1 \sin. 2\pi (t + c_1) + C_2 \sin. 4\pi (t + c_2) + C_3 \sin. 6\pi (t + c_3);$$

and the result compared with the observations. The mean probable error has been obtained by the usual rule, applied to the differences between the number of observed and computed auroras. The formula just mentioned is the same as I employed in 1845 in discussing the daily changes of temperature and magnetic declination at Cambridge, Mass.* In 1843, Eklöf published † at Helsingfors, Russia, a mathematical investigation of the yearly march of auroral phenomena, in which he employed the same periodic function as I have adopted. Copies, however, of the Scientific Transactions, in which Eklöf published his labors, are very rare in this country. I only know of the single one which I had recently an opportunity to examine, in the Astor Library of New York. As Eklöf confined his inquiry to a few places, and to small and imperfect catalogues of auroras, what I have added to his work may not, perhaps, be superfluous.

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* Memoirs of the American Academy of Arts and Sciences. III. 44.

† Acta Soc. Sci. Fennic., etc. II. 302.

I have taken notice, in my memoir, of the attempts made by Mairan, Ritter, Höslin, Quetelet, Wartmann, Boué, Baumhauer, Wolf, A. de la Rive, Fritz, and Littrow to establish relations between the periods of auroral maxima and minima, and those of shooting-stars, meteors, earthquakes, disturbances in the earth's magnetism, or the sun's inflamed surface, and even the larger nutation-period of the earth's axis, to say nothing of hail-storms, snow-storms, lunar halos, winds, etc.

Since the first two hundred and forty pages of my Memoir on the Periodicity of the Aurora have been printed, General Lefroy, formerly director of the Magnetic Observatory in Toronto, Canada, has put at my disposal his large accumulation of observations in British America; also Professor Joseph Henry, Secretary of the Smithsonian Institution, has placed in my hands the unpublished records of meteorology made in various parts of the United States, under the auspices of this institution, in accordance with the comprehensive plan of its accomplished Secretary. Mr. Charles A. Schott has obtained for me, from the original records in possession of the Smithsonian Institution, the dates of one hundred and eight auroras observed by the late Professor Parker Cleaveland, at Brunswick, Maine. During a recent visit to Leyden, I have been able to consult the manuscript records of Musschenbroek. From these I have gathered the observations made in Holland on four hundred and sixty-seven auroras, most of which have never been published before. With these new and rich materials, and others not specified, to which I have had access since my first catalogue was printed, I have been induced to pause in the midst of my discussion of the *secular* periodicity of the aurora, and print supplementary catalogues. I therefore postpone any remarks on this point until the investigation is brought to a conclusion. The sum total of all the independent auroras contained in all my catalogues amounts to eleven thousand nine hundred and fifty-eight. However, the additional observations contained in the second catalogue, embracing, as they do, but a short period of years, will have less influence upon the question of the secular periodicity of the aurora than upon its yearly march from month to month, at Toronto, Quebec, Newfoundland, etc.; for which the observations in the first catalogue were limited to a small number of years.

Number of Auroras observed each Month in the Western Hemisphere.

Place.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Newfoundland,	9	20	14	16	11	5	13	13	16	19	5	10	151
Quebec,	6	25	14	24	7	10	13	10	19	21	13	7	169
London, Canada,	7	12	12	16	6	5	10	8	10	13	3	5	107
Toronto,	21	37	34	46	35	24	31	25	33	43	34	26	389
Jakobshavn,	27	24	17	1	0	0	0	0	17	28	34	37	185
Gothaab,	61	60	50	21	0	0	0	5	53	45	71	64	430
New York State,	76	89	110	132	89	80	106	125	141	117	75	65	1205
New Haven,	63	59	72	67	62	46	72	66	97	62	86	61	813
Newberry,	23	34	28	30	6	2	3	11	32	30	10	9	218
Providence,	15	17	14	13	18	7	10	7	21	21	14	3	160
Burlington,	8	6	9	8	12	5	6	3	8	3	3	3	74
St. Martin,	6	9	7	9	9	4	14	6	14	3	2	6	89
Wilmington,	6	1	4	1	5	5	6	5	10	3	3	4	53
Worcester,	19	13	27	25	10	9	12	19	30	22	15	11	212
Salem,	9	14	18	17	15	15	30	17	21	22	12	8	198
Boston,	2	4	1	5	1	2	2	1	6	2	6	4	36
Cambridge,	19	27	37	39	21	10	29	20	45	33	17	19	316
Cambridge,	17	31	46	33	24	26	44	40	49	32	31	17	390
Aggregates,	394	482	514	503	331	255	401	381	622	519	434	359	5195

Number of Auroras observed each Month in the Eastern Hemisphere.

Place.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Prague,	6	4	4	6	6	1	2	3	4	7	3	1	47
Ratisbon,	1	3	9	9	6	7	2	4	2	8	3	0	54
Holland,	49	47	92	103	110	34	37	59	64	74	47	34	750
Copenhagen,	1	5	9	12	4	0	3	1	4	5	2	2	48
Mannheim,	18	12	33	32	13	8	12	16	28	18	16	10	216
Scandinavia,	40	30	38	11	0	0	0	4	28	49	47	41	288
Sagan,	25	14	34	40	8	2	3	8	22	39	31	14	240
Spydberg,	8	7	17	6	2	0	0	1	10	18	6	6	81
Italy,	4	9	21	5	3	4	6	7	7	12	3	7	88
Wittemberg,	8	12	13	7	3	0	2	11	8	16	5	6	91
Franeker,	20	15	41	23	16	6	8	15	30	30	13	14	231
Montmorenci,	8	13	26	18	14	6	9	11	27	20	11	5	168
Carlsruhe,	2	9	13	15	8	2	5	11	6	8	5	3	87
Paris,	4	5	12	4	20	5	6	10	15	11	12	4	108
Berlin,	21	37	55	48	39	2	10	10	22	45	29	13	331
Upsal,	85	131	152	75	7	2	4	72	126	146	109	109	1018
Brussels,	12	13	18	22	38	23	23	11	16	23	17	15	231
St. Petersburg,	70	100	179	152	42	13	15	62	145	146	83	79	1086
Stockholm,	27	34	50	56	13	0	0	19	44	39	34	25	341
Christiania,	46	61	75	60	3	0	1	35	78	65	55	55	534
Dunse,	33	20	18	18	3	0	2	14	43	34	30	23	238
Makerstoun,	22	26	28	16	6	0	0	7	16	29	23	11	184
Plymouth, Engl.,	8	7	23	12	6	1	8	8	10	15	13	9	120
Great Britain,	21	19	23	12	3	2	1	3	35	23	21	22	185
Kendall, etc.,	18	18	26	32	21	5	2	21	23	36	38	10	250
Hammerfest,	19	16	8	0	0	0	0	0	4	9	16	19	91
Abo, etc.,	66	87	99	61	9	0	2	28	98	97	74	61	682
Jena,	2	9	4	10	4	2	4	8	14	15	6	6	84
Aggregates,	644	763	1120	865	407	125	167	459	929	1037	752	604	7872

Mr. Oliver made a communication on certain ray-numbers in *Compositæ.*

Professor Cooke described a new species of Muscovite Mica containing Lithium and a trace of Rubidium, associated with the Spodumene of Sterling, Mass.

Six hundredth Meeting.

October 13, 1868. — MONTHLY MEETING.

The CORRESPONDING SECRETARY in the chair.

The Corresponding Secretary read letters relative to exchanges; also letters from Dr. H. L. Mansel and Professor Bluntschli in acknowledgment of their election as Foreign Honorary Members, and a letter from Mr. Samuel H. Scudder in acknowledgment of his election as a Resident Fellow.

Professor F. H. Storer presented the following communication: —

On the Simultaneous Occurrence of a Soluble Lead Salt and free Sulphuric Acid in Sherry Wine; with Observations on the Solvent Action of Alcoholic Saline Solutions upon Sulphate of Lead.

Several years since, I was called upon by a wine-merchant of this city to examine a sample of pale sherry taken from a cask which had been returned to him, on the certificate of a chemist that the wine contained lead. The sample in question was perfectly transparent and clear. There was nothing in the appearance or taste of the wine to indicate the sophistication to which it had really been subjected.

On submitting this sherry to chemical analysis, I found not only that it held in solution a considerable proportion of lead, but also a decided trace of free sulphuric acid, besides an abundance of the same acid combined with some alkaline base. When a portion of the wine was evaporated in contact with slips of paper, the latter soon became crumbly and friable.

Regarded merely from the chemical point of view, without reference to its manifest bearing upon questions of hygiene and jurisprudence, the simultaneous occurrence of a lead salt and of free sulphuric acid in alcoholic solution is a fact sufficiently important to merit close attention. Unfortunately, the small sample of wine given me was completely exhausted in the severe confirmatory tests by which the results above mentioned were controlled, and I have had no opportunity to determine the precise manner in which the lead was held in solution in that particular case. Several conjectures as to the cause of the phenomenon will be discussed below.

That lead compounds should still be employed in the treatment of wine will surprise no one familiar with the tenacity with which traditions are held by successive generations of operatives in many of the chemical arts. According to Taylor,* "litharge was formerly much used to remove the acidity of sour wine and convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause; . . . . the adulteration was discovered by Fourcroy, and was immediately suppressed."

Beckmann in his History of Inventions † dwells at some length on the antiquity and enduring character of the practice of neutralizing the acid which spoils wine by means of litharge. According to this author, the practice was forbidden by legal enactment in France as early as 1696, but a hundred years later "the art of improving wine by litharge was taught in England as a method perfectly free from danger." ‡

The sulphuric acid in the sample of wine examined by me was probably added, with the view of removing the dissolved lead resulting from the previous use of litharge. It is not unlikely that the addition of the free acid was preceded by that of a solution of sulphate of ammonium.

In seeking for an explanation of the fact that a certain proportion of lead may remain dissolved in wine, even in presence of free sulphuric acid, the following hypotheses suggest themselves: —

1st. It seemed not impossible, in case a mixture of weak alcohol, dilute sulphuric acid, and sulphate of lead was left to itself for a long time, that a part of the lead salt might be changed to sulphovinate of lead and pass into solution. This idea was sufficiently improbable in view of the known facts that dilute alcohol and weak sulphuric acid are unfit for making sulphovinic acid, and that but little if any of the acid can be formed, even from tolerably concentrated liquids, unless the mixture of alcohol and sulphuric acid be heated artificially. The idea was nevertheless put to the test of experiment, as follows: —

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* On Poisons, p. 502 of the London edition.

† Chapter on Adulteration of Wine.

‡ William Graham's Art of Making Wines from Fruit, Flowers, and Herbs. London, sixth edition.

100 c. c. of alcohol of 59 per cent, 5 c. c. of oil of vitriol, and a quantity of recently precipitated sulphate of lead, were placed in a stoppered bottle, and the mixture was frequently shaken during an interval of three months. The clear liquid was then decanted, diluted with water, and saturated with sulphuretted hydrogen gas. Not the slightest coloration indicative of lead was produced.

100 c. c. of similar alcohol, mixed with sulphuric acid, sulphovinic acid, and sulphate of lead, gave no reaction for lead when tested after the lapse of three months.

2d. Though the idea seemed highly improbable, it was still possible that the sugar in the wine might in some way exert a solvent action upon sulphate of lead. It was found, however, when 100 c. c. of alcohol of 59 per cent, and 5 c. c. of oil of vitriol, together with a quantity of sugar and of precipitated sulphate of lead, were left to themselves for three months, that the clear supernatant liquid held no trace of lead in solution. For that matter, it was found that a mixture of sulphuric acid and much sugar-water was capable of precipitating all the lead even from an aqueous solution of acetate of lead. The filtrate from the sulphate of lead thus precipitated gave absolutely no indication of lead when tested with sulphuretted hydrogen, not even when a considerable quantity of the liquid was evaporated to dryness, incinerated, treated with nitric acid, and again evaporated before applying the reagent.

3d. The most probable hypothesis of all, however, was, that a certain proportion of lead could be held dissolved in presence of sulphuric acid, even in an alcoholic solution like wine, by the action of various soluble alkaline salts capable of decomposing and of being decomposed by sulphate of lead; for it is a well-known fact that very considerable quantities of sulphate of lead can be held dissolved in water by means of many acetates, citrates, and tartrates, and by various other salts.

To test this idea, the following set of experiments has been carried out at my suggestion by Mr. A. H. Pearson, of Haverhill, a student in the Laboratory of the Massachusetts Institute of Technology.

A considerable quantity of dilute alcohol, of the usual strength of sherry wine (18 per cent) having been prepared, standard solutions of acetate of lead, of sulphuric acid, and of sulphate of ammonium were made by dissolving weighed quantities of these substances in portions of the 18% alcohol. Each of the solutions was made of such strength that 500 c. c. of the liquid contained one tenth of an equivalent of the salt or acid, reckoned in grammes, on the hydrogen scale.

Alcoholic solutions of several salts of ammonium and of the fixed alkalies were also prepared, as will be described below.

In each experiment, equal quantities of the standard solution of sulphuric acid, or of sulphate of ammonium, and of the saline solution to be tested were mixed in a glass flask, and the standard solution of acetate of lead was made to fall from a burette drop by drop into the mixture until a persistent precipitate of sulphate of lead was perceived. The burette was graduated so that two drops from it were equal to one tenth of a cubic centimetre; and the flask was constantly shaken while the drops of acetate of lead were falling into it.

The results of the experiments are as follows: —

Acetate of Ammonium was prepared by neutralizing ordinary acetic acid with ammonia-water, and the strong aqueous solution thus obtained was mixed with alcohol. It appeared, however, that this alcoholic solution of the acetate exerted no solvent action upon sulphate of lead, for a permanent precipitate of the latter was produced in the mixture of acetate of ammonium and normal sulphuric acid by the first drop of the standard solution of acetate of lead. The same negative result was obtained in several repetitions of the experiment, even when new portions of dilute alcohol and a second set of the standard solutions were employed.

When, however, the solution of acetate of ammonium was mixed with an equal bulk (10 c. c.) of the standard solution of sulphate of ammonium, instead of the sulphuric acid, a considerable quantity of sulphate of lead was held in solution by it. In two distinct trials, the precipitate formed by dropping acetate of lead into the mixed solution of acetate and sulphate of ammonium continued to redissolve until 3 c. c. of the standard solution of acetate of lead had been added to the liquor. These 3 c. c. of the standard solution contained 0.1137 grm. of acetate of lead, corresponding to 0.0909 grm. of sulphate of lead.

To hold dissolved 1 part of sulphate of lead in the dilute alcohol charged with sulphate of ammonium, there was consequently required 110 c. c. of a tolerably strong solution of acetate of ammonium.

Still another experiment with sulphuric acid was made by mixing 10 c. c. of an entirely new preparation of acetate of ammonium with a similar quantity of the standard solution of acetate of lead, and dropping the standard sulphuric acid into the mixture. No persistent precipitate was produced in this case until 5 c. c. of the acid had been added. This quantity of the standard acid contained 0.049 grm. of sulphuric acid corresponding to 0.1515 grm. of sulphate of lead; hence only 33 parts of the solution of acetate of ammonium were required to dissolve 1 part of sulphate of lead. It is to be observed that the insolubility of tartrate, citrate, and succinate of lead in alcohol prevents the application of this modified form of the experiment in the examples given below. With the exception of the acetates of ammonium and sodium, none of the salts experimented with can be mixed with the acetate of lead and subsequently tested with sulphuric acid or sulphate of ammonium.

Acetate of Sodium, whether mixed with the normal sulphuric acid, with sulphate of ammonium, or with acetate of lead, seemed to have no solvent action upon sulphate of lead.

Neither *Oxalate of Ammonium* nor normal *Oxalate of Potassium* exerted any solvent action either in presence of the sulphuric acid or the sulphate of ammonium.

Tartrate of Ammonium. — Normal, crystallized tartrate of ammonium was dissolved in alcohol of 18%, in such proportion that 500 c. c. of the solution contained $\frac{1}{10}$ of an equivalent, 18.4 grms. of the salt. 25 c. c. of the solution was mixed with an equal volume of the normal sulphuric acid, and normal acetate of lead was added to the mixture until a permanent precipitate was produced. To effect this result, there was required of the standard solution of acetate of lead 2 c. c. or 0.0758 grm. of the acetate, corresponding to 0.0606 grm. of sulphate of lead. The 25 c. c. of the solution of tartrate of ammonium contained 0.92 grm. of the dry salt. Hence, something more than 15 parts of tartrate of ammonium are required to hold 1 part of sulphate of lead dissolved in dilute alcohol containing free sulphuric acid.

In two other experiments where the tartrate of ammonium solution was mixed with the sulphate of ammonium instead of with free sulphuric acid, 3 c. c. of the acetate-of-lead solution had to be added before a permanent precipitate could be formed.

That sulphuric acid is a more efficient precipitant of lead in presence of tartaric acid than sulphate of ammonium was shown in another way. 30 c. c. of the standard alcoholic acetate of lead were mixed with an equal volume of the standard solution of tartrate of ammonium. The precipitated tartrate of lead was filtered, and the filtrate mixed with a quantity of the sulphate of ammonium solution. No precipitate was produced, though on the subsequent addition of sulphuretted hydrogen a slight precipitate of sulphide of lead was formed. In a similar experiment, where sulphuric acid was substituted for sulphate of ammonium, a slight precipitate was produced by the sulphuric acid, and no precipitate could be obtained afterwards with sulphuretted hydrogen.

In two other experiments where 5 c. c. of the acetate-of-lead solution were mixed with 30 c. c. of the tartrate of ammonium, no precipitate was produced by sulphate of ammonium in the filtrate from the tartrate of lead, while sulphuric acid gave a slight precipitate as before. In this case, however, sulphuretted hydrogen gave a slight precipitate after sulphuric acid, as well as after sulphate of ammonium.

Normal *Tartrate of Potassium* mixed with the solution of sulphuric acid exerted no solvent action on sulphate of lead.

Succinate of Ammonium, prepared by neutralizing a solution of succinic acid with ammonia-water, exerted no solvent action when mixed with the free sulphuric acid; but when mixed with the solution of sulphate of ammonium, 6 c. c. of the acetate-of-lead solution were added to the liquor before a permanent precipitate fell.

Normal *Citrate of Ammonium* was prepared by neutralizing a weighed equivalent portion of crystallized citric acid with ammonia-water. 10 c. c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the standard solution of acetate of lead was dropped into the mixture in the usual way. No permanent precipitate was formed until 16 c. c. of the lead solution had been added. These 16 c. c. contained 0.6064 grm. of acetate of lead, corresponding to 0.4848 grm. of sulphate of lead. The 10 c. c. of citrate-of-ammonium solution contained 0.42 grm. of crystallized citric acid. Hence, 1 part of sulphate of lead was held dissolved in the mixture of alcohol and dilute sulphuric acid for every 0.8663 part of citric acid in the liquor.

On repeating the experiment, a precisely similar result was obtained: 16 c. c. of the standard lead solution had to be added to the mixture of alcohol and sulphuric acid before the precipitate ceased to redissolve as fast as it formed.

In two other experiments where, instead of free sulphuric acid, 10 c. c. of the standard solution of sulphate of ammonium were mixed with 10 c. c. of the citrate-of-ammonium solution, 30 c. c. of the standard lead solution had to be added, in each case, before any permanent precipitate formed.

Dicitrate of Ammonium ($C_{12}H_6(NH_4)_2O_{14}$) was prepared in crystals, and 22.6 grms. of the salt were dissolved in 500 c. c. of the 18% alcohol. 25 c. c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the acetate-of-lead solution was dropped into the mixture in the usual way. After the addition of 8 c. c. of the standard acetate of lead, a permanent precipitate was produced. These 8 c. c. contained 0.3032 grm. of acetate of lead, corresponding to 0.2424 grm. of sulphate of lead. The 25 c. c. of dicitrate-of-ammonium solution contained 1.13 grms. of the dry salt. Hence, 1 part of sulphate of lead was held dissolved for every 4.6617 parts of the dicitrate.

Tricitrate of Potassium. — 25 c. c. of a standard solution of ordinary crystallized citrate of potassium, mixed with an equal volume of the standard sulphuric acid, gave no permanent precipitate until 2 c. c. of the solution of acetate of lead had been added to it.

Sugar. — A standard solution of cane sugar, mixed with an equal volume of the sulphuric acid, gave a permanent precipitate, on the addition of the first drop of the acetate of lead.

These experiments show clearly that very considerable quantities of sulphate of lead can be held in solution by weak alcohol charged with various salts. It may, therefore, reasonably be inferred that wines sometimes retain lead in solution, in consequence of this action of the acids and salts peculiar to wine upon lead compounds ignorantly employed to correct acidity.

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Eleventh Annual Report of the Board of Guardians of the Chicago Reform School to the Common Council of the City of Chicago, for the Year ending March 31, 1867. 8vo pamph. Chicago. 1867.

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Thirteenth Annual Report of the Board of Directors for the Year ending August 1, 1867. 8vo. St. Louis. 1867.

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Report of the Librarian of Congress, for the Year ending December 1, 1866. 8vo pamph. Washington. 1867.

Spon (*E. & F. N.*).

Catalogue of Scientific Books, comprising Agriculture, Annuities, Architecture, Brewing, Chemistry, Civil and Mechanical Engineering, etc. 8vo. London. 1867.

Stevens (*Hon. T.*).

Speech of Hon. T. Stevens, of Pennsylvania, delivered in the House of Representatives, March 19, 1867, on the Bill (H. R. No. 20), relative to Damages to Loyal Men, and for other Purposes. 8vo pamph. Washington. 1867.

Storer (*Prof. F. H.*).

Chili. Notice Statistique sur le Chili. 8vo pamph. Montereau.

Pérou. Notice sur le Guano de Pérou. 12mo pamph. Havre. 1867.

Studi sul Corpo Luteo del Vacca. Adolfo Lieben et E. Piccolo. [Estratto dal Giornale di Scienzi Naturali ed Economiche. Vol. II.] 4to pamph. Palermo. 1867.

Sulla Costituzione dei Carburi d'Idrogeno C_n H_{2n}. Adolfo Lieben. [Estratto dal Giornale. . . . . Vol. II.] 4to pamph. Palermo.

Sintesi degli Alcoli per mezzo dell' Ettere Clorurato. Adolfo Lieben. [Estratto dal Giornale. . . . . Vol. II.] 4to pamph. Palermo.

On the alleged Hydrothermal Origin of certain Granites and Metamorphic Rocks. By David Forbes, F. R. S., etc. [Extr. from the Geological Magazine, Vol. IV. Nos. 2 and 5.] 2 pamphs. 8vo. London. 1867.

Catalogue of Contributions transmitted from British Guiana to the Paris Universal Exhibition of 1867. Printed for the Committee of Correspondence of the Royal Agricultural and Commercial Society. 8vo. London. 1867.

Letter to His Grace the Duke of Buccleuch, President Elect of the British Association for the Advancement of Science, 1867 – 68, on the Quadrature of the Circle. By James Smith, Esq. 8vo pamph. Liverpool and London. 1867.

Sumner (*Hon. Charles*).

Report of the Superintendent of the Coast Survey, showing the Progress of the Survey during the Years 1863, 1864, 1865. 4to. 3 vols. Washington. 1864, 1866, 1867.

Report of the Committee on the Conduct of the War. On the Attack of Petersburg, on the 30th day of July, 1864. 8vo. Washington. 1865.

The One-Man Power. Address delivered by Hon. Charles Sumner, at the Music Hall, Boston, October 2, 1866. 12mo pamph. Boston. 1866.

Speech of Hon. Charles Sumner, of Massachusetts . . . . on the Cession of Russian America to the United States. 8vo pamph. Washington. 1867.

Letter from the Secretary of War, in Answer to a Resolution of the House, of December 20, 1866, transmitting Report of the Chief of Engineers, with General Warren's Report of the Surveys of the Upper Mississippi River and its Tributaries. 8vo pamph. Washington. 1867.

Supplemental Report of the Joint Committee on the War, in two vols. 8vo. Washington. 1866.

Northwestern America: showing the Territory ceded by Russia to the United States. Compiled for the Department of State, at the United States Coast Survey Office. B. Peirce, Superintendent. 1867. Map. Washington. 1867.

Annual Report of the Board of Regents of the Smithsonian Institution . . . . for the Year 1866. 8vo. Washington. 1867.

Report of the Commissioner of Agriculture, for the Year 1866. 8vo. Washington. 1867.

Argument of Hon. Charles Sumner: Can the Chief Justice presiding in the Senate rule or vote? Unbroken Series of Authorities against this Claim. 8vo pamph. Washington. 1868.

Reconstruction. Speech of Hon. Lot M. Morrill, of Maine, in the Senate of the United States, February 5, 1868. 8vo pamph. Washington. 1868.

Opinion of Hon. Charles Sumner, of Massachusetts, in the Case of the Impeachment of Andrew Johnson, President of the United States. 12mo pamph. Washington. 1868.

Validity and Necessity of Fundamental Conditions on States. Speech of Hon. Charles Sumner, of Massachusetts, in the Senate of the United States, June 10, 1868. 8vo pamph. Washington.

Trembley (*J. B., M. D.*).

Annual Meteorological Synopsis for the Year 1866, in the City of Toledo, Ohio. 8vo pamph. Toledo.

Warren (*J. Mason, M. D., etc.*).

Surgical Observations, with Cases and Operations. 8vo. Boston. 1867.

Washburn (*Emory, LL. D.*).

Testimony of Experts. A Paper read before the American Academy of Arts and Sciences. [From the American Law Review.] 8vo pamph. Boston. 1866.

Remarks: Policy and Management of the Boston and Worcester Railroad. 8vo pamph.

Washington (*Hon. Peter G.*).

Oration delivered before the Association of the Oldest Inhabitants of the District of Columbia, in Washington, 4th of July, 1867. 12mo pamph. Washington. 1867.

Wetherill (*Charles M., Ph. D., M. D., etc.*).

Experiments on Itacolumite (Articulite), with the Explanation of its Flexibility, and its Relation to the Formation of the Diamond. . . . . 8vo pamph. New Haven. 1867.

Whitney (*William Dwight, Prof. of Sanskrit, and Instructor in Modern Languages, in Yale College*).

Language, and the Study of Language: Twelve Lectures on the Principles of Linguistical Science. 8vo. New York. 1867.

Wilder (*Burt G., S. B., M. D.*).

Researches and Experiments upon Silk from Spiders, and upon their Reproduction. By Raymond Maria de Termeyer, a Spaniard. Translated from the Italian. Revised by Burt G. Wilder, S. B., M. D. [Extr. from the Proc. of the Essex Institute. Vol. V.] 8vo pamph. Salem. 1866.

Wilson (*Hon. Henry*).

Memorial Address on the Life and Character of Abraham Lincoln, delivered at the Request of both Houses of the Congress of America before them, in the House of Representatives, at Washington, on the 12th of February, 1866. By George Bancroft. 8vo. Washington. 1866.

Report of the Joint Committee on Reconstruction, at the First Session, Thirty-Ninth Congress. 8vo. Washington. 1866.

Report of the Secretary of the Treasury, on the State of the Finances, for the Year 1866. 8vo. Washington. 1866.

Report of the Commissioner of Agriculture, for the Year 1865. 8vo. Washington. 1866.

Annual Report of the Commissioner of Patents, for the Year 1865. Vols. I., II., III. 8vo. Washington. 1867.

Winkler (*T. C.*).

Musée Teyler. Catalogue Systématique de la Collection Palæontologique. 4e et 5e Livr. 2 pamphs. 8vo. Harlem. 1865, 1866.

Wyman (*Jeffries, M. D., etc.*).

Observations on Crania. 8vo pamph. Boston. 1868.

Six hundred and first Meeting.

November 11, 1868. — STATUTE MEETING.

The VICE-PRESIDENT in the chair.

The Vice-President called the attention of the Academy to the recent decease of Mr. Octavius Pickering of the Resident Fellows.

On the motion of the Librarian it was *voted*, That the duplicate volumes of the Massachusetts Laws now in the Library of the Academy be given to the Historical Society of New York.

The following gentlemen were elected members of the Academy.

Nathaniel E. Atwood, of Provincetown, to be a Resident Fellow in Class II., Section 3.

Dr. Hermann Hagen, of Cambridge, to be a Resident Fellow in Class II., Section 3.

Horace Mann, of Cambridge, to be a Resident Fellow in Class II., Section 2.

Alpheus S. Packard, Jr., of Salem, to be a Resident Fellow in Class II., Section 3.

Edmund Quincy, of Dedham, to be a Resident Fellow in Class III., Section 3.

Sir Charles Wheatstone, of London, to be a Foreign Honorary Member in Class I., Section 3, in the place of the late Sir David Brewster.

Herrmann Ludwig Ferdinand Helmholtz, of Heidelberg, to be a Foreign Honorary Member in Class I., Section 3.

Six hundred and second Meeting.

December 8, 1868. — MONTHLY MEETING.

The VICE-PRESIDENT in the chair.

The Vice-President called the attention of the Academy to the decease of Mr. Horace Mann, of Cambridge, since the last meeting, at which he was elected a Resident Fellow.

A letter was read from Professor A. Braun, of Berlin, of the Committee on the Ehrenberg Testimonial, in answer to an official communication from the President.

Professor Winlock reported the preparation, by the Rumford Committee, of a list of Count Rumford's works.

Six hundred and third Meeting.

January 12, 1869. — MONTHLY MEETING.

The VICE-PRESIDENT in the chair.

On the motion of Professor Winlock, a committee was appointed to memorialize Congress relative to appropriations to aid in the observation of the solar eclipse of August, 1869.

The following gentlemen were appointed on this committee: Professor J. Winlock, Dr. Thomas Hill, Mr. J. I. Bowditch, Professor J. D. Runkle, and Mr. Thomas Sherwin.

On the motion of Commodore Rodgers, the committee were requested to communicate to other learned bodies the wishes of the Academy.

On the motion of Mr. Folsom, Professor Pickering was requested to prepare for the Academy a communication on the Spectroscope and its uses.

Six hundred and fourth Meeting.

January 27, 1869. — STATUTE MEETING.

Honorable C. F. Adams was chosen President *pro tempore*.

Professor Runkle was appointed to serve as Secretary *pro tempore*.

In the absence of the chairman and other members of the committee, Professor Runkle reported that the committee appointed at the preceding meeting to prepare a memorial to Congress for aid in observing the total eclipse of the sun, on the seventh of August next, had attended to the duty assigned them.

Six hundred and fifth Meeting.

February 9, 1869. — MONTHLY MEETING.

The VICE-PRESIDENT in the chair.

In the absence of the Recording Secretary, Dr. S. Kneeland was appointed Secretary *pro tempore.*

The Vice-President announced that the committee appointed to memorialize Congress for a grant of money for the observation of the eclipse of the sun, August 7, 1869, having attended to that duty, had received an answer from Honorable G. S. Boutwell that the steps necessary to secure the grant would be taken.

Mr. Paul B. DuChaillu, present by invitation, gave a brief account of the geography and meteorology of Equatorial Africa.

Professor J. D. Whitney gave an account of his recent investigations in California into the subject of the occurrence of human remains and works of art in rocks considered by him as being of Pliocene age. He remarked: —

That while nothing had been discovered to invalidate the testimony brought forward at the meeting of the National Academy, in August last, at Northampton, in regard to the Calaveras County skull, important additional evidence of other discoveries of a similar character had been obtained. There are now three distinct cases of the occurrence of human remains or works of art in rocks of Pliocene age, known to him, each vouched for by the testimony of respectable witnesses, given under circumstances in which there was no possibility of collusion or probability of deceit. As I have opportunity I am diligently engaged in collecting facts on this important subject, and, without unnecessary delay, the whole will be laid before the scientific world in proper form, and properly illustrated with maps and sections.

Six hundred and sixth Meeting.

March 9, 1869. — MONTHLY MEETING.

In the absence of the regular presiding officers, Mr. John A. Lowell was chosen to take the chair.

The Recording Secretary read letters from Dr. Herrmann Hagen, acknowledging his election into the Academy, and from Dr. C. A. Martius, of Munich, announcing the death of his father, Dr. Carl Friedrich Philipp von Martius; also letters relative to exchanges, and a letter from a committee of the Suffolk District Medical Society, asking the co-operation of the Academy in discussing the subject of expert testimony. This communication was referred to a committee of the Academy appointed in March, 1866, to consider the same subject; and this committee were authorized to add to their number.

Professor E. C. Pickering made a communication on the Spectroscope, with experimental illustrations of its various constructions and its uses in chemistry and astronomy.

Six hundred and seventh Meeting.

April 13, 1869. — MONTHLY MEETING.

In the absence of the regular presiding officers, Mr. John A. Lowell was chosen to take the chair.

Mr. Ritchie exhibited some of the effects of monochromatic light by means of an apparatus producing a bright sodium light.

Six hundred and eighth Meeting.

May 11, 1869. — MONTHLY MEETING.

In the absence of the regular presiding officers, Hon. C. F. Adams was chosen to take the chair.

Professor Peirce made the following communication: —

The phenomena which were ably presented by the distinguished geologist, Mr. Lesley, to the National Academy of Sciences, and which seem to demonstrate that the outer shell of the earth has sensibly shrunk, in some directions at least, since its original formation, naturally invite the attention of physicists to the possible causes of such a result. The most obvious cause of the shrinking of the earth is its cooling. But to shrink two per cent linearly, which is that deduced by

Mr. Lesley from the observed geological phenomena, involves a probable cooling of the whole earth of not less than two thousand degrees centigrade, which would require that its original temperature should be higher than would be consistent with the solidity of these shrunk strata.

Another source of change of form, which would produce shrinkages in different directions in different parts of the earth, is to be found in the diminution of oblateness arising from the diminished velocity of rotation upon the axis. Such diminution of the velocity of rotation has several years ago been shown by Mr. Ferrel to be caused by the action of the moon in producing the tides; this is, therefore, a true cause, and it is only necessary to examine how great its amount can be under any circumstances. This is all which is proposed in the present investigation, and the application to facts is reserved for geologists.

It is sufficient, for the present object, to regard the earth as homogeneous. Under this condition Laplace has shown that the time of the earth's rotation could not be less than about one tenth of a day, which corresponds to a ratio of the axis of the equator to that of the pole, equal to 2.7197, and an equatorial circumference 94 per cent greater than the present one. Such is then the amount of shrinking which might have taken place, if any cause could be assigned capable of producing so great a reduction of the earth's velocity. The whole surface of the earth would have been about 130 per cent larger than at present.

But the only cause at present known which would produce a sensible reduction of the earth's velocity is the lunar action upon the tides. But in this mutual action between the moon and the earth, the common rotation area of the earth and moon must remain unchanged. The question then arises, How great a reduction of the rotation area of the earth would have passed into that of the moon? In this inquiry it may be assumed that the moon revolves in a circular orbit in the plane of the earth's equator. Now the moon's rotation area is 3.716 times the earth's. But if, in the origin, it had revolved just in contact with this earth, its rotation area would not have been less than 0.480 times the earth's, so that it could not have absorbed a rotation area from the earth greater than 3.236 times the earth's present rotation area, and therefore the earth's rotation area could never have exceeded 4.236 times that which it has at present. But, with the maximum velocity of rotation given by Laplace, the earth's rotation area would have been

37½ times greater than at present. It can never, therefore, have been reduced to so great an extent by the moon's action on the tides. But since, when the oblateness is small, the rotation area is nearly proportional to the velocity, and the excess of the square of the equatorial above that of the polar axis is nearly proportional to the square of the velocity, this excess may have been originally nearly 18 times as great as at present, or about 15½ per cent of the square of the polar axis. This would correspond to a figure of the earth in which the equatorial radius would have been about 2½ per cent greater than at present; so that it is sufficient to account for the observed phenomenon.

This peculiar form of shrinkage would produce the highest mountains at the equator, and the tendency of the mountain ranges would then be to assume the direction of the meridian. But nearer the poles the mountains would be less elevated, and would rather tend towards the direction of the parallels of latitude.

It is, next, expedient to consider the mechanical question of the loss of living force in the case of the moon's action upon the waters of the earth, and its effect upon their different motions. In this connection there are problems worthy of the attention of Geometers; such as the relative motions of bodies rotating above the same vertical axis, towards which they are drawn by weights, and acting upon each other through the friction on the axis. For one of the bodies a rotating wheel may be substituted. There is also the case of two planets revolving about a primary, and acting upon each other through some form of friction.

In this way, it will be seen that the planet or satellite once formed is constantly removed from the primary, and that planets tend to approach each other. It is interesting to consider whether this may not be one of the actual problems of nature.

Six hundred and ninth Meeting.

May 25, 1869. — ANNUAL MEETING.

In the absence of the regular presiding officers, Hon. Robert C. Winthrop was chosen to take the chair.

The Chairman called the attention of the Academy to the recent decease of Hon. William Mitchell and of Dr. William Allen, both of them Resident Fellows.

It was voted to adjourn this meeting at its close to the second Tuesday in June.

It was voted to adjourn the stated meeting of August to the second Tuesday of September.

Professor Runkle and Mr. Hill were appointed scrutineers of the election of officers, and Professor Watson and Dr. White scrutineers of the election of members.

It was voted to close the polls at five o'clock.

The Treasurer's report, duly audited, was received and ordered to be entered on the records.

Dr. Pickering presented the report of the Library Committee, which was accepted.

The report of the Rumford Committee, presented by Professor Winlock, was accepted, and a recommendation to present the Rumford Premium to George H. Corliss, for his improvements in the Steam-Engine, was adopted.

It was also voted, in accordance with the recommendations of this Committee, "That the sum of one hundred and twenty-eight dollars and fifty-six cents of the income of the Rumford Fund be appropriated for the purchase of certain books for the Library of the Academy.

"That the sum of three hundred dollars be appropriated for the purchase of spectroscopic instruments to be used, under the direction of the Committee, in observing the solar eclipse of August next.

"That one thousand dollars of the income of the Rumford Fund be appropriated for continuing the publication of the new edition of Count Rumford's works which has been begun by the Academy."

Mr. F. W. Putnam addressed the Academy on the approaching meeting, at Salem, of the American Association for the Advancement of Science.

Professor A. Agassiz, Dr. White, and Professor F. H. Storer were appointed a committee to consider what action the Academy should take on the occasion of this meeting.

The following appropriations were voted for the ensuing year: —

For General Expenses, from the General Fund . .	$ 2,200
" " from the Rumford Fund .	200
For Publication	800
For the Library	500

The following gentlemen were elected members of the Academy: —

William T. Brigham, of Boston, to be a Resident Fellow in Class II., Section 1.

Algernon Coolidge, of Boston, to be a Resident Fellow in Class II., Section 1.

Alfred P. Rockwell, of Boston, to be a Resident Fellow in Class I., Section 4.

Alpheus Hyatt, of Salem, to be a Resident Fellow in Class II., Section 3.

Edward S. Morse, of Salem, to be a Resident Fellow in Class II., Section 3.

The annual election resulted in the choice of the following officers for the ensuing year: —

Asa Gray, *President.*
George T. Bigelow, *Vice-President.*
William B. Rogers, *Corresponding Secretary.*
Chauncey Wright, *Recording Secretary.*
Charles J. Sprague, *Treasurer.*
Frank H. Storer, *Librarian.*

Council.

Thomas Hill, Josiah P. Cooke, John B. Henck,	of Class I.
Louis Agassiz, Jeffries Wyman, Charles Pickering,	of Class II.
Robert C. Winthrop, George E. Ellis, Andrew P. Peabody,	of Class III.

Rumford Committee.

JAMES B. FRANCIS,	JOSEPH WINLOCK,
MORRILL WYMAN,	WOLCOTT GIBBS,
WILLIAM B. ROGERS,	JOSIAH P. COOKE,

FRANK H. STORER.

Committee of Finance.

ASA GRAY, }
CHARLES J. SPRAGUE, } *ex officio*, by statute.
THOMAS T. BOUVÉ, by election.

The other Standing Committees were appointed on the nomination of the President, as follows: —

Committee of Publication.

JOSEPH LOVERING,	JEFFRIES WYMAN,

FRANCIS J. CHILD.

Committee on the Library.

FRANCIS PARKMAN,	CHARLES PICKERING,

JOHN BACON.

Committee to audit the Treasurer's Accounts.

CHARLES E. WARE,	THEODORE LYMAN.

Professor Whitney presented for publication the following letter from Baron Richthofen, giving an account of the geological investigations in China up to March 1, 1869: —

I returned a few days ago from an exploration of the country adjoining the Yang-tse-kiang, between Shanghai and Han-kau, a distance of six hundred geographical miles. I hired a fine boat, which was towed up the river by steamer, and then dropped gradually downward, exploring right and left from the various stations which I made. The trip, which occupied altogether forty-five days, afforded much of interest, and I believe that I have established a good basis for further operations. You may be surprised that I selected a region which is so easy of access, and which would hardly seem to be invested with that charm of novelty which remoter portions of this vast Empire might afford. But the excellent charts existing of the lower part of the Yang-tse exhibit only its banks and shallows, while the country immediately adjacent is, with the exception of a few places, even less known than the borders of the upper portion of the river, above Han-kau.

In attempting to give you a brief *résumé* of some of my results, I must remark that I give them only as a preliminary notice, and am quite prepared to see them corrected and enlarged by my own future examinations.

This was the first opportunity I had for getting somewhat acquainted with the sedimentary formations of any part of China. I soon became aware that I must abandon the views taken by my predecessors in Chinese geology, and had better commence from the *a b c*. Mr. Pumpelly's distinction of one great granite-metamorphic formation, one great (Devonian) limestone formation, and one great subdivision embracing the Chinese coal-measures, of which a Triassic age was made probable by Dr. Newberry, was based on observations made in other parts of China. I found it quite insufficient for the country which I visited, while the addition, by Kingsmill, of the Tung-ting sandstones, which he considers to fill out the gap between the granite and the "great limestone formation," was a slight step in advance, but not one by any means representing the variety of formations. The task of establishing their order of succession was not easy, and I had to work hard to accomplish this end. But the amount of evidence increased with the number of good sections, and I had the good fortune to find fossils in several localities, one of which is of some importance, as it yielded a large number and variety of shells in an excellent state of preservation, establishing for the rocks in which they occur the age of the mountain-limestone. These rocks can easily be recognized, and appear to be widely distributed in China.

I give you the list of formations, with the local denomination, which I used in my note-books, and on my geological maps, for convenience' sake only, that I may refer to them in any letter I may send you hereafter. The lowest formation observed is, —

1st. *Ta-ho sandstone,* a series of coarse variegated sandstones, not interrupted, so far as my observations extend, by conglomerates or shales. Red, lilac, purple, green, are the prevailing colors. Some beds are hard, but the greater part of the sandstone is remarkably soft, considering that it belongs to a very ancient formation. Even where it is inclined at high angles, it retains this soft texture, unless this has undergone a change in the immediate neighborhood of eruptive rocks. The Ta-ho Mountains, a picturesque range of nearly two thousand feet in height, and situated about fifty miles east of Kiu-kiang, are almost entirely built up of these sandstones. They are here slightly inclined, and exposed in a thickness of at least two thousand five hundred feet. At another place I estimated the visible portion of the formation at four thousand feet; but, as I never saw its lowest strata, nor the underlying rocks, those figures mark the minimum of the actual thickness.

2d. *Liu-shan schists.* — This is a series of shales of from twelve hundred to three thousand feet in thickness, which are quite characteristic, being the only rocks of this kind on the lower Yang-tse. The formation appears, from the descriptions given of rocks occurring south of that river, to be largely distributed in eastern China, and to form a valuable horizon. The shales are, for the most part, clayey and sandy, and not unfrequently converted into clay-slate. The color varies from yellow and red in the former to dark green and gray in the latter varieties. An abundance of undeterminable remains of plants may be found. This formation and the former are distinguished from all those of subsequent age, by being usually intersected by numerous veins of white quartz. The Liu-shan is a short but very conspicuous mountain range, near Kiu-kiang, rising abruptly to the altitude of probably little less than three thousand five hundred feet. The shales form a belt at its eastern foot.

3d. *Matsu limestone.* — On the Matsu-shan, a prominent hill in the belt just mentioned, I observed, for the first time, the conformable superposition of limestone on the Liu-shan schists. I confirmed afterwards the observation in several other places. These are dark limestones, distinguished in their lowest portion by a ribboned appearance of all planes of fracture which intersect the stratification. It is caused by the predominance of silica in alternate layers. The main body of the limestone shows a certain brecciated structure and a dolomitic appearance. Chert is abundant, but I found no characteristic fossils. The thickness of the formation is at least two thousand feet; but as I never saw distinctly its upper portion, this figure may be too low. The deposition of these strata was followed by, —

4th. A period of *great disturbances and outbreaks of granite.* — The three formations which I have mentioned compose long ranges of hills, and I know of one instance only, namely, the Ta-ho range, where they can be observed in an almost undisturbed position; generally they are inclined at steep angles, and contorted. Granite, in most instances, enters into the structure of these ranges, though in a varying way, now intersecting the strata in large intrusive masses and veins, now accompanying them separately. It has, however, had a comparatively slight metamorphosing influence. The purer limestone is converted into a coarse white marble; the impure qualities are represented by thick beds of a highly silicious, slightly dolomitic, and imperfectly crystalline limestone of yellow color. The sandstone is partly converted into quartzite, and the shale into clay-slate.

The granite also occurs by itself in mountain ranges. A bold range, prominent by its rugged outlines, as well as by its altitude (about three thousand five hundred feet), which rises abruptly out of the alluvial plain of the Yang-tse near the large city of Ngan-king, and accompanies the river on its left bank for quite a distance, is completely built up of granite; in a few places only, marble and quartzite indicate detached portions of the strata which were intersected by the granite.

It is probable that this granitic outburst marks one of the main features in the geology of eastern China, as there is little doubt that to it belongs the granite which, together with porphyry, composes almost exclusively the coast of China between Ningpo and Hong-Kong, a distance of seven hundred geographical miles. I observed it at Suchau, in the group of the Chusan Archipelago, and on the island of Hong-Kong. The granite of these three localities resembles that on the lower Yang-tse, not only in its petrographic character, but also in its geological features, as it is accompanied in these different places by detached and quite irregular portions of altered shales and quartzites. These and marble are mentioned, too, from nearly every place along the granitic coast of which I have any information. If the supposition of this identity, or rather contemporaneity, of the granitic outbursts of eastern China should prove correct, we may look for it as a guide in the geology of eastern Asia in general; although I am inclined to believe, from former observations in Shantung, that there was still an older granitic epoch, connected with the thorough metamorphism of a more ancient series of formations than those here mentioned.

5th. *Tung-ting sandstone.* — All the formations which are now to be mentioned were not affected by the disturbances immediately connected with the outbreak of the granite. Probably the lapse of time between the deposition of 3 and 5 was of long duration, and it is quite likely that the gap may comprise a series of sedimentary deposits which are not visible at the surface in the regions visited by me. I did not even see in any place the lowest portion of the Tung-ting sandstones. They form a rather uniform series of very hard, almost quartzose sandstones, which are visible in a thickness of at least four thousand feet, and form bold mountain ranges for themselves alone, the Liu-shan among others. The name was first used by Kingsmill, and is derived from the island of Tung-ting-shan in Taihu Lake, sixty miles west of Shanghai.

This is the only formation in regard to the position of which I do not feel quite certain. The next formation is, however, conformably underlain by what I consider to be the topmost layers of the Tung-ting sandstone, namely, a series of hardened, nodular clay, hard sandstone, and conglomerate of pebbles of quartz.

6th. *Si-hio limestone.* — This is a limestone formation of only six hundred feet in thickness. The rock is full of chert nodules, and contains numerous fossils, chiefly corals, encrinites, and brachiopods. *Aulopora repens* is of frequent occurrence among them, and other forms, too, indicate a *Devonian* age. The name is derived from a prominent hill, generally known as Single-tree hill, east of Nan-king, where I first found the fossils.

7th. *Nan-king grits.* — The last formation is conformably overlain by a gritty and purely quartzose sandstone, alternating frequently with a coarse conglomerate of perfectly rounded pebbles consisting exclusively of quartz. The color is mostly red, but where the strata are inclined at steep angles, light shades prevail, though the former color is still visible in concentric rings of a dark red color, which give a variegated appearance to every plane of fracture. Although this formation is largely developed at and around Nan-king, and forms bold hills capped with a coarse conglomerate, and rising to more than a thousand feet, I was unable to determine its thickness. It probably far exceeds two thousand feet. Certain dark shales which occur in the way of interstratification contain fossil plants, but I found no specimens that could be determined.

8th. *Kitau limestone.* — This is an important formation, overlaying the last conformably. Its name is derived from a prominent bluff situated midways between Han-kau and Kiu-kiang, called Kitau, or

Cock's Head, which is well known as a landmark to the navigator of the Yang-tse. There are three subdivisions of this formation: —

a. The lower limestone. Hard, silicious varieties of light gray and reddish colors, carrying frequently an abundance of chert, prevail. The thickness of the layers varies from that of card-paper to many feet. The chert nodules increase in some places so much in quantity as to form complete layers by themselves, and lenticular masses of chert are frequently embedded in a soft calcareous sandstone interstratified in thin beds between the limestone. Traces of fossils may often be found in them. The limestone itself is frequently filled with, and in certain layers nearly made up of, the shells of a *Fusulina* which is distinguished from *Fusulina cylindrica* only by its more perfect cylindrical shape. I collected many beautiful specimens of it. This lower limestone is about fourteen hundred feet thick.

b. A series of black sandy shales, black lydite, and soft sandstones. The lowest strata are highly fossiliferous, chiefly at Tso-dsu-kang near Ching-kiang, which is the before-mentioned distinguished locality. Large specimens of *Productus semireticulatus*, with shell, interior structure, and spines well preserved, would be sufficient for themselves to indicate the age of the *mountain-limestone.* They are accompanied by numerous other brachiopods, bivalves, corals, and Fenestellas, the latter being quite a prominent feature. I collected sufficiently to give pleasant occupation to a geologist who would take the trouble to work up the material. The place where they were found is quite a curiosity. There are a number of abandoned shafts, the waste dumps of which afford an easy opportunity for collecting the fossils; otherwise they could hardly be discovered, as the ground is covered by vegetation. As no reason for mining is apparent, it would at first seem as if a past generation had opened the shafts for the delight of future stray geologists, until one hears that these were flint-mines; indeed, lenticular masses of chert are quite frequent in the soft strata. I may mention, besides, that among the fossils here found are none of those brachiopods which have been long since famous as an article of trade in the Chinese drug-stores. I believe, for various reasons, that they are derived from the Si-hio limestone before mentioned. The soft sandstone which follows higher up in this series carries a *bed of coal,* the lowest in position which I have found. All the mines once opened on this bed are abandoned, evidently at or little below water-evel. But the coal appears to be of inferior quality, and not more than one or two feet thick. There is a remarkable regularity in the occurrence of this bed of coal, and of the entire formation, with its lydite and other distinguishing features, over a wide extent of country. I found it in places four hundred miles distant from each other. The thickness of this formation is about four hundred feet.

c. Upper limestone. It is separated from the coal only by a thin stratum of black shale, and is similar in nature to the lower limestone. I observed its thickness for sixteen hundred feet, but never saw its upper portion.

The thickness of the entire formation is thus at least three thousand four hundred feet, but I am prepared to see it proved to be several thousand feet thicker by future observation. The Kitau limestone composes entire mountain ranges by itself alone, chiefly between Kiu-kiang and Han-kau. Kingsmill mentions, as overlaying the Tung-ting sandstone of the Liu-shan to the west, a limestone formation of an estimated thickness of six thousand feet; it is probably altogether Kitau limestone.

9th. *Sanghu sandstone and conglomerate.* — The deposition of the Kitau limestone ended with a considerable disturbance, as the next formation follows quite unconformably. It consists of quartzose sandstone and quartzose conglomerate, interstratified with thick layers of red clay, and carries a coal-bed at a place sixty miles below Han-kau. Black shales, which overlie the coal, carry some remains of plants. I was unable to establish the thickness of this formation.

10th. *Commencement of the outbreaks of porphyry.* — The porphyritic eruptions have probably continued in China during a long period, while sediments were contemporaneously deposited. Pumpelly was the first to direct attention to these wide-spread events. But it is only in the great granitic region of the eastern coast, between Ningpo and Hong-Kong, that porphyry itself arrives at an extraordinary development. The Chusan Islands are almost exclusively composed of quartzose porphyry and its tufas, and from there southward it appears to be only subordinate in quantity to the granite. I know it from my own observations on the island of Hong-Kong, and by inference from the observations of others, of the region between that island and Ningpo. This is the most extensive development of porphyry known in any part of the world.

11th. *Deposits of porphyritic tufa, sandstones, and clays.* — The porphyries themselves are little developed on the lower Yang-tse. I noticed their first appearance in certain porphyritic tufas which overlie somewhat unconformably the Sanghu sandstone. The latter appears, indeed, from its purely silicious character, to have been antecedent to any outbreak of porphyry, while the soft and impure nature of all subsequent deposits goes to show that they were the tufaceous sediments of eruptions in remote regions. The visible thickness of this formation below Han-kau is about three thousand five hundred feet. It encloses a few beds of coal of subordinate value.

Herewith ends, on the lower Yang-tse, the series of the ancient formations. The only two horizons which I consider as fairly established are Nos. 6 and 8, the Devonian and the Carboniferous. To the latter belongs the lowest coal-bed, and it is for this reason that I do not consider the question regarding the age of the Chinese coal-measures in any way as settled. It must, on the other side, however, be taken into consideration, that, from a comparison of the formations of the lower Yang-tse with those observed by Pumpelly near Peking, the coal-bearing formation appears to be but very imperfectly represented in the former country. To this circumstance may have to be ascribed the scarcity of workable coal-beds in the region over which my observations extend. It is by no means improbable that the upper beds belong to a different formation not represented in that region.

After a long interruption there were deposited on the lower Yang-tse a series of apparently very recent sediments, the age of which, however, could in no instance be determined.

a. Tatung deposits, a series of hard, cemented sediments of clay, sand, and detritus, which, by the angular shape of the fragments and their petrographical nature, bears evidence of its derivation, at every place, from the next adjoining hills. These strata, though always inclined in a certain direction at angles of from ten to fifteen degrees, do not occupy at any place a higher level than two hundred feet above the river. I did not find any fossils in them.

b. Volcanic rocks. There is, north of Nan-king, a group of extinct volcanoes, whose isolated cones rise immediately out of the alluvial plain to an elevation of five hundred to seven hundred feet. Their lavas are dolerite and basalt. The craters are well preserved.

c. Horizontal beds of gravel. They are probably buried deep underneath the alluvium of the Yang-tse, as the only place where they are exhibited is at the volcanoes of Nan-king. Each of those I visited is surrounded by a narrow ring of these beds, which are horizontally stratified and form the slopes of the volcanoes up to an altitude of four hundred feet. They probably owe this singularly isolated position to a local elevation of the volcanic district, which may have taken place long after its vents were extinct.

d. Loess, which cannot be distinguished from the European Loess. It composes terraces two hundred feet high, and contains shells of Helix. It is sometimes separated from the underlying rocks by a layer of Laterite.

e. Alluvium of the great plain.

The different formations here enumerated compose, on the right and left bank of the lower Yang-tse, a series of detached and apparently disconnected mountain ranges. The complete sequence of sedimentary formation can only be constructed out of the various part-sections which those ranges severally afford. But no sooner are the geological columns put down on a map than the unity of the whole system of ranges is conspicuous. They form together, so to say, one great geological range, which is directed from southwest to northeast, parallel to the course of the Yang-tse from Kiu-kiang to Nan-king. There may be distinguished an axial core, consisting of the three most ancient formations and granite, while those of subsequent age are distributed on both flanks of it. On the northwestern flank a somewhat regular sequence of them may be observed, commencing with those following immediately on the granite, and ending with the post-porphyritic deposits. It forms, between the Liu-shan and Han-kau, a belt of one hundred and fifty miles in breadth, and is cut at right angles by the Yang-tse. The hills between Ching-kiang and Nan-king constitute a belt of similar construction, though much more narrow, on the southeastern flank. I use the term "axial core" in a purely geological sense, as the formations composing it do by no means occupy the centre of actual mountain ranges, nor do they excel by the altitude to which they rise. Though the granitic mountains near Ngan-king are about three thousand five hundred feet high, most of the hills composed of those ancient formations would but slightly attract the attention of the topographer. West of Poyang Lake, for instance, the upturned edges of the oldest sediments constitute a low plateau, and rise only in a few hills to about six hundred feet, while the more recent Tung-ting grits compose, in the immediate vicinity, the high and abrupt range of the Liu-shan.

You may be surprised not to find in the above list of formations the nummulitic limestone of Si-Tungting, which I mentioned in a former letter, and which belongs properly to the system of the lower Yang-tse. The reason is, that I will refrain from maintaining my former, perhaps too positive assertion, before the fossils, which have so perfectly the structure of nummulites, shall have been examined by an authority on the subject. The structure of these shells, the occurrence, with them, of certain gastropods which, though hardly determinable (on account of their fragmentary condition), do not have the character of any that are usually found in ancient formations, the state of preservation of the fossils which permits even the color of some bivalves to be recognized, — all this is in strange contradiction with the similarity of the limestone of Si-Tungting to some of the most ancient limestone strata on the Yang-tse. The occurrence of encriuites, too, in the former, — a fact which I think I forgot to mention in my former letter, — is not in accordance with the Eocene age of the limestone in question. I never found on the lower Yang-tse any fossils resembling those of Si-Tungting.

I am endeavoring to collect data for the geological history of eastern China in recent periods. There is, among others, one very interesting feature in the valley of the lower Yang-tse, which bears on that subject. You would, in ascending the river by steamer, observe that it is, in the greater part of its course below Han-kau, accompanied by terraces, which rise abruptly out of the alluvial plain to an altitude of from sixty to two hundred feet above it, now approaching the river closely, now remaining at a distance of several miles from its banks, sometimes skirting the foot of a mountain range, then again forming an extensive table-land. You might consider them, from analogy, to correspond to the so-called diluvial terraces so common in the valleys of great rivers. It is a striking fact, that, on examination, the terraces of the Yang-tse prove to be quite different in nature, consisting as they do mostly of the upturned edges of ancient formations, not of one of them, but of all, excepting granite, porphyry, and the limestones. The strata are inclined at various angles, and their ends abraded in nearly horizontal planes. On Poyang Lake, the terraces consist of the two most ancient formations (1 and 2) ; below Han-kau, for sixty miles, they are composed of the soft sandstones and clays No. 11, while near Ngan-king they are built up of Tatung sediments. At Nan-king, finally, the river is accompanied for about fifty miles, on either side, by terraces consisting of the Nan-king sandstones and conglomerates, which are here inclined at an angle of forty-five degrees. This phenomenon appears to mark at least one epoch when the sea was gradually encroaching on the land, and, though probably not rising high above its present level, contributing to effect a remarkable change in the configuration of the country. I refrain for the present from any further remarks on recent changes. Only this I may still mention, that I did not discover any signs of former glacial action or drift.

It is much to be regretted that there is not more knowledge of geology to be found among the numerous travellers in China; if there were, our knowledge of the geology of this vast Empire might be rapidly enlarged. I am sorry to say, that, with the exception of Mr. Kingsmill, I have not met one who has any knowledge of this science. I am left quite to myself; and the more I travel, the more I become convinced how little can be done by one man in so vast a country. Still, I hope to be able to lay at least some sort of foundation, which may perhaps guide even those who have not the necessary scientific education, and stimulate further exploration. But more than this I shall hardly be able to accomplish.

Six hundred and tenth Meeting.

June 8, 1869. — ADJOURNED ANNUAL MEETING.

In the absence of the regular presiding officers, Mr. Thomas Sherwin was chosen to take the chair.

The vote of the previous meeting, adjourning the August meeting to the second Tuesday in September, was reconsidered. Professor Joseph Lovering was chosen Corresponding Secretary, and Professor Edward C. Pickering was chosen a member of the Rumford Committee, to fill vacancies made by the resignation of Professor William B. Rogers.

The Council made the following report: * —

During the year which preceded the annual meeting of May, 1869, eight Resident Fellows, three Associate Fellows, and five Foreign Honorary Members have been added to our lists, viz.: —

Captain Nathaniel E. Atwood, of Provincetown, to be a Resident Fellow in Class II., Section 3.

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* Unavoidably delayed, and not presented until the meeting of January 26, 1870.

Professor W. J. Clark, President of the Massachusetts Agricultural College, to be a Resident Fellow in Class I., Section 3.

Dr. Herrman Hagen, of Cambridge, to be a Resident Fellow in Class II., Section 3.

John L. Hayes, of Cambridge, to be a Resident Fellow in Class II., Section 1.

Horace Mann, of Cambridge, to be a Resident Fellow in Class II., Section 2.

Dr. Alpheus S. Packard, Jr., of Salem, to be a Resident Fellow in Class II., Section 3.

Mr. Edmund Quincy, of Dedham, to be a Resident Fellow in Class III., Section 3.

Samuel H. Scudder, of Cambridge, to be a Resident Fellow in Class II., Section 3.

James B. Angell, President of the University of Vermont, to be an Associate Fellow in Class III., Section 4.

Hon. Lewis H. Morgan, of New York, to be an Associate Fellow in Class III., Section 2.

Andrew D. White, President of Cornell University, Ithaca, New York, to be an Associate Fellow in Class III., Section 2.

Professor T. C. Bluntschli, of Heidelberg, to be a Foreign Honorary Member in Class III., Section 1, in the place of the late Professor Mittermaier.

Professor Herrman Ludwig Ferdinand Helmholtz, of Heidelberg, to be a Foreign Honorary Member in Class I., Section 3.

Professor Lassen, of Bonn, to be a Foreign Honorary Member in Class III., Section 2, in the place of the late Professor Bopp.

Professor Ritschl, of Bonn, to be a Foreign Honorary Member in Class III., Section 2, in the place of the late Professor Boeckh.

Sir Charles Wheatstone, of London, to be a Foreign Honorary Member in the place of the late Sir David Brewster, in Class I., Section 3.

During the same year, death has removed from our ranks five Resident Fellows, one Associate Fellow, and one Foreign Honorary Member.

Levi Lincoln, LL. D., was born in Worcester, Massachusetts, on the 25th of October, 1782, and died in that city on the 29th of May, 1868. He was the eldest son of the Hon. Levi Lincoln, an eminent lawyer, who was the Attorney-General of the United States during the first term of Mr. Jefferson's Administration. Having been graduated at Harvard College with the class of 1802, he pursued the profession in which his father had been so distinguished, and, like him, was soon called off from the bar to engage in political affairs. He was a member of the Senate of Massachusetts in 1812; a representative in the State Legislature in 1814; a member of the Convention to revise the Constitution in 1820; Speaker of the Massachusetts House of Representatives in 1822; Lieutenant-Governor of the State in 1823; and, soon after retiring from this office for a brief service on the Bench of the Supreme Court, he was elected Governor of Massachusetts in 1825. In this capacity he served the State with conspicuous fidelity and ability for nine successive years, and fairly won the title of a model magistrate. In 1834 he was chosen a Representative in the Congress of the United States, and continued in that office for seven years. In 1841 he was appointed Collector of the Customs for the port of Boston, and, on quitting that post in 1843, he was immediately returned to the Senate of Massachusetts, and in the following year was made President of that body. In 1848 he was chosen President of the Electoral College of Massachusetts; and as late as 1864, while in his 82d year, he once more discharged the office of a Presidential Elector. In the mean time he had enjoyed the distinction of being the first Mayor of his native town, after it was incorporated as a city, and had rendered valuable service to the community in which he lived, as President of the Worcester Agricultural Society. His long and honored life was thus devoted to the public interests of the Commonwealth and the country; while his spotless integrity and private virtues commanded the respect and esteem of all who knew him. His memory is among the treasures of Massachusetts, and will be cherished by all who appreciate the value to a free State of a patriotic and upright magistrate, and of a public-spirited and useful citizen.

The **Rev. William Allen**, D. D., was the son of the Rev. Thomas and Elizabeth (Lee) Allen, and was born in Pittsfield, Massachusetts, on the 2d of January, 1784, being the ninth of twelve children. His father was the first minister of Pittsfield. Dr. Allen claimed to be descended, through his mother, from Governor Bradford of Plymouth Colony.

He was graduated at Harvard College in 1802, and pursued the study of theology with the Rev. John Pierce of Brookline. In 1804 he was licensed by the Berkshire Association, and preached for some months in the western part of New York. Returning to Massachusetts, he succeeded the Rev. Dr. Channing as Regent in Harvard College. While in that office, besides performing the duties which pertain to it, he prepared the first edition of his "American Biographical and Historical Dictionary," which was published in 1809 by William Hilliard, in Cambridge, containing notices of about seven hundred Americans. It comprised six hundred and thirty-two pages in octavo. It is claimed that this was the first book of general biography published in this country. It certainly reflects great credit on the industry and research of the compiler. Two years before the publication of this work, Dr. Allen had prepared notices of a number of American divines for the Rev. David Bogue's "History of the Dissenters," which was first published in London in 1809. The second edition of Dr. Allen's Biographical Dictionary was published in 1832 by William Hyde of Boston, in a large octavo of eight hundred pages. This volume is said to contain over eighteen hundred names. The third edition, in a still enlarged form, was published in 1857 by John B. Jewett & Co. of Boston. This contained notices of over seven thousand Americans. In 1810, when Dr. Allen's connection with the College was dissolved, he delivered the Phi Beta Kappa oration. In October of that year he was ordained pastor of the church in Pittsfield, as his father's successor. The Legislature of New Hampshire, in 1816, altered the charter of Dartmouth College, making it a University, and Dr. Allen, in the following year, was chosen its President. This action of the Legislature originated the famous Dartmouth College case, which, on an appeal to the Supreme Court at Washington, resulted, in 1819, in the maintenance of the rights of the College against the State. In 1820, Dr. Allen was appointed President of Bowdoin College, in Maine, and he retained this office till his resignation in 1839. Since this time he lived at Northampton, Massachusetts, engaging in various literary labors. He made a large collection of words not found in any dictionary of the English language; nearly fifteen hundred being contributed to Worcester's Dictionary published in 1846, more than four thousand to Webster's, 1854, and about six thousand for the new edition of Webster's.* To what extent these large collections of words, thus contributed, were incorporated in the works above named, we are not informed, as no acknowledgments appear in the Prefaces to indicate it. Among other works of Dr. Allen may be cited: Baccalaureate Addresses, 1823 – 29; Junius Unmasked, written to prove that Lord Sackville was the real Junius; Account of Shipwrecks, Psalms and Hymns, 1835; Memoirs of Eleazar Wheelock and of Dr. John Codman, 1853; An Historical Discourse on the Fortieth Anniversary of the Second Church in Dorchester, 1848; Discourse on the Close of the Second Century of the Settlement of Northampton, Massachusetts, 1854; Wunnissoo, or the Vale of Hoosatunnuk, a poem, with notes, 1856; besides various minor productions. In 1812, Dr. Allen married Maria M. Wheelock, daughter of President Wheelock. The degree of D. D. was conferred upon him by Dartmouth College in 1821. He died at Northampton on the 16th July, 1868.

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* These memoranda are taken from the New American Cyclopædia, included in a notice of Dr. Allen, from which, indeed, this sketch is mainly compiled.

OCTAVIUS PICKERING was born in Wilkesbarre, Pennsylvania, September 2, 1791, where his father resided six years, having removed thither from Philadelphia, to which city he returned in 1792. In 1801 his father came back to Massachusetts, and settled near Salem. Octavius was admitted to the Freshman Class in Harvard University in 1806, and was graduated in 1810. He studied law in the office of his brother, John Pickering, was admitted to practice in 1816, and took an office in Salem, where he continued to reside during a few years, until his removal to Boston, in which city and in Cambridge he lived the remainder of his life, excepting an absence of seven years in Europe, mostly spent in England and France. He died in Boston, October 29, 1868.

He early began the practice of reporting. In 1820 he reported the proceedings in revising the Constitution of Massachusetts, and in 1821, with his friend, William H. Gardiner, reported the trial on the impeachment of Judge Prescott. Though he did not practise what is technically called short-hand, yet he had adopted many abbreviations, and was quick in hearing, and rapid and accurate in penmanship; so that at the time of his appointment, in 1822, as reporter to the Supreme Court, he had superlative qualifications for that position, which he held eighteen years, during which time, and subsequently, he was employed in making and publishing his reports.

His brother, John Pickering, had pretty early begun to gather materials for the biography of their father, Timothy Pickering, who was Quartermaster-General in the war of the Revolution, subsequently Secretary of War and of State, a member of each house of Congress, and always an active and earnest public man, — the history of whose life was involved in the party divisions and contests of a stirring epoch, and led his biographers — first, John, and afterwards, Octavius — into a minute investigation of the characters, acts, and events of the whole period in which he took so decided and distinguished a part. Accordingly, the first step for Octavius, after the task of the biography had passed into his hands on the decease of his brother John, was to get together, under his hand, the appalling mass of materials in the form of records, publications, printed documents, and attainable private correspondence. This he did with great diligence, and not without considerable expense. His copies of letters and documents, so collected, consist of some fifty large volumes, which he carefully read through, at least twice, consecutively, besides comparing the contents, and rearranging them in a comprehensive index, before he began to determine on the selections to be made for the first volume, and to fill in the intermediate spaces with explanations, and the notice of collateral circumstances, in such a manner as to make a connected chain. The first volume was completed and published in 1867. At his request the continuation of the biography has been put into the hands of Mr. Charles W. Upham, of Salem.

As Reporter, Mr. Pickering necessarily kept up his acquaintance with the law, and he never neglected the Greek and Latin classics. During his residence in France, he had, of course, become more familiar with the French, which language he read fluently, with a distinct pronunciation. He read widely and diligently in history, was a constant attendant at scientific lectures, and always present at the Lowell course. He also took great pleasure in the study of Botany, though he did not make pretensions to a comprehensively scientific knowledge of it. If, in walking leisurely with a friend, he noticed on the wayside a flower at all remarkable for beauty, rarity, or otherwise, he was wont to point it out to his companion, and was in the habit of bringing home specimens to be examined under the microscope. He took an active part in founding the Society of Natural History of New England, and regularly attended its meetings.

Mr. Pickering was social, cheerful, and acceptable in society, and his time never hung heavily with him at home, where a great part of his occupations lay.

In the course of his life he was a member of different associations of a private rather than a public character, consisting of members of literary, social, and political distinction, in which his characteristic modesty did not prevent him from taking an active part. He had a remarkably pleasant voice and distinct utterance, and could read aloud an indefinite time without fatigue to his auditors or himself.

He was a man of most amiable disposition, pleasing manners, and lively wit, without poignancy or sarcasm; a devoted and enduring friend, admired and confided in by all, and never knowing what it was to have an enemy. He never unduly urged his pretensions, nor had he need to, for during his life he was surrounded by those who knew his worth.

George Rapall Noyes, the son of Nathaniel and Mary (*née* Rapall) Noyes, was born in Newburyport, March 6, 1798. While a pupil in the public schools of his native town, he manifested a taste and aptness for study which attracted the attention of his pastor, the late Rev. Dr. Dana, who encouraged and aided him, both by advice and by the loan of money. In 1814 he entered Harvard College, where he maintained his place as a faithful and successful scholar, graduating in 1818. He had defrayed a portion of his expenses by teaching country schools in the winter, and immediately on leaving college he took charge of the Framingham Academy, thus securing a sufficient income to clear himself from debt, and to start with some small savings on his proposed course of more advanced study. In 1819 he entered the Cambridge Divinity School, and in 1822 was licensed as a preacher. But he had become too much engrossed in the literature of his profession to forsake the university for the active duties of the ministry. He continued at Cambridge for eight years longer, holding at first the duties of a proctor, with some private pupils whose tuition-fees eked out his frugal means of living, and for the last two years employed as a tutor in the classical department. By this time it had become quite generally known that he had been devoting himself with great assiduity and singleness of purpose to the Hebrew language and scriptures. In 1827 he became pastor of the First Congregational Church in Brookfield. Though the leisure which so small and retired a parish might give him for study had no inferior place among his motives in accepting the invitation, he yet was conscientiously faithful in his ministerial charge, and established life-long relations of mutual respect, affection, and gratitude with his parishioners. Shortly after his settlement he published his translation of Job, which gave him at once a foremost place among distinguished scholars in that department of learning. In

1834 the insufficiency of his support compelled him to resign his charge at Brookfield. He then accepted a pastorate at Petersham, where he had a peaceful, happy, and prosperous ministry of six years. In 1840 he was invited to fill the chair of Hebrew and other Oriental Languages and Biblical Literature in Harvard University. He retained this office till his death, and, though for many months he had suffered from illness and physical infirmity, he remained in the full exercise of his mental powers, and with unimpaired ability for his duties as a teacher, till within a few days of his decease, which took place June 8, 1868.

He received the degree of Doctor of Divinity from Harvard University in 1839. He was chosen a member of the American Academy in 1844. Elected to other learned bodies, he declined membership from an unwillingness to be enrolled where he could not render active service.

Dr. Noyes's principal publications in his lifetime were the version of Job, already mentioned, which passed through four editions; a translation of the Book of Psalms, and a translation of the Hebrew Prophets, of both of which three editions were published; and a translation of the Proverbs, Ecclesiastes, and Canticles, of which there were two editions. Besides these, he published numerous tracts, occasional sermons, and articles in periodicals. His latest work, nearly ready for the press when he died, and issued in the following autumn, was a translation of the New Testament, in which he condensed the results of his life-long study of the Sacred Records, and which he regarded equally as the ripest fruit of his scholarship, and as his last and best offering upon the altar of Christian faith.

These works are the most adequate memorial of their author's mind and culture. They indicate untiring industry, profound study, keen critical acumen, thorough grasp of the subject in hand, full command of the materials and resources of critical inquiry, and that just apprehension of the intent and spirit of the books belonging to the sacred canon, without which no amount of learning or skill could have made him a good translator. We have no space for the minute examination of the merits of his translations in themselves, or as compared with other similar works. Suffice it to say that he who should pronounce either of them superior to any other extant translation of the same books might see ample ground for such an opinion, both in the tokens of exhaustive research and in the marks of sound and sober judgment to be found in them all.

Dr. Noyes's moral character was well adapted to aid his success and worthy fame as a critic. He was at once reverent and bold, — reverent for all truth, as one with God, but wholly destitute of prescriptive reverence for what had been held as truth, until it had shown its credentials and established its claim. He thus pushed his inquiries to the utmost limit; but while he rejected many things which others held sacred, no man ever had a firmer faith than he (a faith which seemed to him as strongly grounded as if it had been susceptible of mathematical demonstration) in the divine mission and authority of the Founder of Christianity, and in the authenticity of the records through which his life and character have been transmitted. Himself a free and fearless inquirer, he claimed for others the same liberty, and regarded honest dissent, denial, and scepticism with uniform respect and kindness.

As a writer he was simple, chaste, perspicuous, and at the same time concise, with little ornament, but with instructive rather than careful heed to the canons of pure taste and accurate diction. As a preacher, he was plain, sensible, serious, and weighty, impressing his hearers with his own sincerity, and most esteemed by those whose esteem is of the most worth.

In private life no man could be more worthily loved. Happy in those who shared his home, he made his home happy. Faithful, kind, genial, hospitable, he had equally the unlimited confidence and the warm affection of all who stood in near or intimate relation with him; and while his modesty and his retired life may have given him fewer personal friends than his reputation would have brought him, those who knew him well knew him only to love and honor him. The last three or four years of his life were marked by unintermitted debility and suffering; and for a long period he was seldom able to cross his own threshold, his classes coming to him in his study. During this whole season he manifested entire resignation, serene Christian trust, a patience never disturbed, and an engagedness in his wonted pursuits which had not begun to flag when he was laid upon his death-bed. As a Christian scholar, he merits a foremost place among his contemporaries; as a Christian man, he has his record, equally, we trust, in grateful and reverent memories on earth and in the book of life eternal.

HORACE MANN was elected into the Academy on the eleventh of November last; and he died the same night. Devoted to Natural

History almost from childhood, and trained to investigation in one department, in which he had made successful explorations in a distant field, he was confidently expected to add new celebrity to the distinguished name he inherited, when a career of unusual scientific promise was thus suddenly arrested.

He was the eldest son of the late Hon. Horace Mann (of whom it is unnecessary here to speak), and was born in Boston on the 25th of February, 1844; therefore had not completed the 25th year of his age. His earlier studies were pursued mainly under the immediate direction of his parents, with both of whom education was a specialty. Soon after his father's death the family removed from Antioch College, just as Horace was prepared to enter upon the regular course. He studied at Concord for some time with private tutors, and then entered the Scientific School at Cambridge, giving himself first to Zoölogy, especially Conchology, under Professor Agassiz, and afterwards to Botany under Professor Gray. In 1864 he joined his friend William T. Brigham in a visit to the Sandwich Islands by way of the Isthmus and California; and they explored this group in company, Mr. Mann taking the Botany as his particular department, while Mr. Brigham attended more to the Geology and Mineralogy. On his return to Cambridge he took up the special study of Hawaiian plants, and rejoined the Scientific School of Harvard University. Upon applying for the degree of Bachelor of Science (which he obtained with honors in 1867), he laid before his examiners, as his thesis, an elaborate and critical "Enumeration of Hawaiian Plants," which was deemed worthy of a place among the publications of this Academy. It fills almost one hundred pages of the seventh volume of our Proceedings, and has been recognized in the botanical world as a contribution of sterling value. It had been preceded by two other papers in the Proceedings of the Boston Society of Natural History upon certain new plants of the Sandwich Islands, and it was to be followed by a complete Flora of those Islands for the use of general botanists on the one hand, and of the residents of the country on the other, such a work being a desideratum for both. Mr. Mann had actually written out the greater part of it, and three fasciculi were printed by the Essex Institute; it is hoped that the work may be completed from the notes and materials left by him. The smaller papers and articles contributed by Mr. Mann to the Boston Natural History Society and to scientific journals are at least twelve in number. All his writings, in their simplicity, directness, order, and the total absence of pretence and show, may recall to those who knew him well somewhat of the traits of the man, — his great modesty, singleness and tenacity of purpose, and disinterested devotion to science for its own sake. Looking back over the very few years which were allotted to him, we wonder at the amount of work he was able to accomplish, as represented in these publications. They are the fruits, apparently not so much of youthful enthusiasm, which was not lacking, as of conscientious, unremitting, and well-directed labor. Moreover, they were brought forth under delicate health, and, at length, under the ravages of an insidious disease, and amid other onerous if congenial duties. He was for several years, and until the end, Curator of Botany to the Natural History Society; for the last two years Curator to the Herbarium of Harvard University, and assistant to the Professor; and last autumn, under an appointment as College Tutor, he took the whole charge of the Botanical department, and the superintendence of the Botanic Garden, in the absence of the Professor. But his powers soon failed under the rapid development of pulmonary disease; he was called away from his chosen work just when he had given proof of rare capacity for performing it, and from this Society almost at the moment when we had numbered him as our own.

WILLIAM MITCHELL was born at Nantucket, Mass., on the 20th of December, 1791, and died at Poughkeepsie, N. Y., on the 19th of April, 1869. His opportunities for education were no better than those which the Island at that time afforded. The remembrance of his early school-days was associated with the severe discipline common at that period, so that the recollection of his school experiences gave him little pleasure. He said, in a brief sketch of his life, written for his oldest granddaughter, that no teacher inspired him with any love of learning.

Although his father was in comfortable circumstances, he followed the custom of the lads of the town, and learned the cooper's trade at the age of fifteen; giving it up, however, almost immediately, and entering a school, as Assistant, at eighteen, and as Principal soon after.

Mr. Mitchell married, on the 10th of December, 1812, Lydia Coleman, whom he had known from his boyhood. This union lasted forty-eight years. Ten children were born to them, of whom nine survive. In a memoir, written by himself, he says: "All that my children are, physically and morally, is attributable, under Divine Providence, to that talented and excellent woman. Never were the duties of wife and mother more conscientiously performed."

In the war of 1812, the property, mostly in ships, of Mr. Mitchell's father was greatly impaired, and the most rigid economy was demanded of the son, in order to support his young family. He left his school and engaged with his father in an oil-factory and cooperage. In 1822 he resumed school-keeping, which he always loved; and when the public schools were established in his native town, he was one of the first two teachers appointed. Finding this occupation too laborious, he relinquished it in a few years, and again started a private school. In 1830 he gave this up also, and became secretary in an insurance office. In 1837 he took charge of the Pacific Bank as cashier, and, at nearly the same time, of a savings-bank. Both these offices he held for about twenty years. In 1861, being nearly seventy years of age, he retired from all business, and removed to Lynn, where two of his daughters resided. In 1865 he followed his distinguished daughter, Miss Maria Mitchell, to Vassar College, near Poughkeepsie, N. Y.

Although Mr. Mitchell was little of a politician, he held many honorable positions in the State. He was a member of the Convention for the Revision of the Constitution of Massachusetts, in 1820. Twenty-four years afterwards he was a member of the State Senate, and later still of the Council of Governor Briggs, to whom he was much attached. He was elected a member of the Board of Overseers of Harvard College for six years, and, at the expiration of that time, he was re-elected by an almost unanimous vote of both Houses.

From his earliest years, Mr. Mitchell was interested in the study of Astronomy, having inherited the taste from his father. His mathematical learning was not sufficient to carry him through its difficult calculations, but Bowditch's Navigator and the Nautical Almanac were thoroughly studied. He calculated carefully, and observed successfully the eclipse of February 12, 1831, which was *annular* at Nantucket. With a small spy-glass he caught an early sight of Halley's comet, at its last return in 1835. He was one of the first, if not the very first, to see it in this country. Mr. Mitchell was familiar also with meteorological phenomena, of which he kept a record for about half a century. His eye was quick to detect any change in nature. For some years he made observations for the United States Coast Survey, in order to determine the latitude and longitude of Nantucket.

Mr. Mitchell said modestly of himself: "I have somehow had a scientific reputation, although never entitled to it, and in middle life held quite a position among astronomers of that day." To the scientific atmosphere in which he delighted, and which he shed around his own home and neighborhood, the world is indebted for the gifted astronomical observer and computer, Miss Maria Mitchell. In 1831, the daughter, though only thirteen years old, counted time for her father while he observed the annular eclipse of the sun. From that time until his death, the two worked together in perfect sympathy. Although Mr. Mitchell had no official connection with Vassar College, where he passed the last years of his life with his daughter, he rendered valuable aid in its organization by his wisdom, his gentleness, and his long experience as Overseer of Harvard College and member of its visiting committees. The years spent in the Observatory of Vassar College were remarkably happy. Only a year before his death he wrote thus: "With scarcely a circumstance to throw a shade over my declining years, I have made acquaintances among teachers and professors which a prince might envy." And again he wrote: "I have had my days of sorrow and of trial, but I know of no man, living or dead, whose life has been so exempt from the evils common to mankind."

Without much strength of constitution, Mr. Mitchell lived to the advanced age of seventy-seven, and died at length of old age. He approached death, not only with calmness, but with cheerfulness. Although an invalid for the last year of his life, and confined to his room for several months, his mind lost none of its vigor, and his interest in physical science continued without any abatement to the end. He listened to the reading of a letter a few hours before he died, and spoke only a few minutes before he ceased to breathe.

Mr. Mitchell's character was that of the Christian gentleman. By his sweetness and gentleness he won the love of all around him. He had many friends, and it was scarcely possible that he could have a single enemy. He was a lover of peace, and shed the sunshine of peace into whatever circle he entered. A Quaker by birth, and always in harmony with that sect, he illustrated in perfection its many excellent characteristics. He was more of a thinker than a reader or writer, and, under more favorable circumstances, might have been widely known as a discoverer of truth. His principal writings are: A highly appreciative account of the early history and achievements of the Observatory of Harvard College, published in the Christian Examiner for March, 1851; two communications upon the Tails of Comets, printed in Volume XXXVIII. of the American Journal of

Science, April, 1840, and Volume XL., April, 1841; a brief account of the Aurora of May 29, 1840, contained in Volume XXXIX. of the same journal for October, 1840; an account of the discovery of the Comet of October 1, 1847, by his daughter, Miss Maria Mitchell, for which she received the comet medal, offered by the King of Denmark, also in the same journal, Volume V., N. S., for May, 1848. In Volume IX. of the Second Series of the American Journal of Science, Mr. Mitchell has given a brief notice of the scientific tastes and attainments of Walter Folger, of Nantucket. The theory which Mr. Mitchell suggested, and skilfully defended, in regard to the tails of comets, asserted that they "are formed by the sun's rays, slightly refracted by the nucleus, in traversing the envelope of the comet, and uniting in an infinite number of points beyond it, throwing a stronger than ordinary light on the ethereal medium, near to or more remote from the comet, as the ray, from its relative position and direction, is more or less refracted." Later in life, he felt the difficulties of his own, as of all other theories, on this perplexing subject.

Charles Frederick Philip von Martius, the distinguished botanist and traveller in Brazil, was born at Erlangen on the 17th of April, 1794, and died at Munich, December 13, 1868. He came of a learned stock: one of his ancestors, Galeottus Martius, born at Ravenna in 1428, was librarian of the celebrated library of Matthias Corvinus, King of Hungary; a great-uncle was the author of a Flora of Moscow (the first edition of which, all but two copies, was consumed in the conflagration of that city); and his father (who lived to a very advanced age) was one of the three founders of the oldest botanical Society extant, the *Botanische Gesellschaft* of Ratisbon. His botanical teacher at the University of Erlangen was Schreber, who had studied under Linnæus. His earliest work — his thesis for the doctorate — was his *Enumeratio Horti Botanici Erlangensis*, in 1814. When, after the death of Schreber, his collections were purchased for the Bavarian Academy, the veteran Schrank was sent to Erlangen to convey them to Munich. He there found in young Martius a student of such promise that he attracted him to the Bavarian capital and employed him as his assistant in the Botanic Garden. Here, while acting practically as superintendent of the establishment, Martius was noticed by King Maximilian, and soon after was selected by him to be one of the two naturalists (Dr. Spix being the other) which that enlightened monarch had insisted upon adding, at his own expense, to the scientific staff which the Austrian government attached to the squadron which was to convey to Rio the Austrian princess, about to become Empress of Brazil. They embarked at Trieste in the spring of 1817; and during the ensuing three years these two naturalists, with very moderate means and appliances, made those extended explorations and precious collections which — along with those of Humboldt — form the principal foundation of our knowledge of the natural history of Brazil, especially of the Amazon, which they ascended to within the frontiers of Peru.

The health of Dr. Spix gave way under the fatigues and exposures of these explorations; and he died a few years after his return to Europe, shortly after the commencement of the publication of the extended series of works destined to record the results of the expedition. The whole burden now fell upon Dr. Martius, with such assistance as he could command from his pupils or others. For the ichthyological collection he called upon a young zoölogist, then a student at Munich, now our own colleague, who thus made his first essay in the study of the natural productions of that vast stream which he was destined personally to explore, many years afterwards, under better than regal auspices. The second and third volumes of the *Reise in Brasilien*, which will compare favorably with Humboldt's "Personal Narrative," and the great Atlas, were entirely by Martius. For the *Nova Genera et Species Plantarum Brasiliensium*, he had the assistance of Zuccarini only in the first volume. This work forms an epoch in botanical illustration, not only for the completeness and excellence of the analyses, but also as the earliest application to this purpose of the newly invented art of *engraving* upon lithographic stone.

His greatest work — one specially adapted to the author's genius and multifarious learning, and without doubt the most sumptuous and elaborate of all botanical monographs — is the *Historia Palmarum*, in three elephant-folio volumes, and containing two hundred and forty-five plates. Begun in view of the Brazilian species merely, it was soon expanded to embrace the whole noble family of Palms throughout the world; and its completion in 1850, crowning eighteen years of labor, inseparably and for all time connects the name of Martius with these princes of the vegetable kingdom, as Linnæus aptly terms them.

While this last work was still in progress, and after some essays in a humbler form, Von Martius planned, and in the year 1840 commenced the publication of, the folio *Flora Brasiliensis*, — the grandest particular flora ever undertaken. It began under the auspices of the sovereigns of Austria and Bavaria, and was afterwards liberally fostered by the Brazilian government. The forty-seven parts, — some of them, in fact, volumes, — already published, comprise almost one hundred natural orders, and more than eight thousand species, of which fully one thousand four hundred are illustrated by figures. With the essential aid recently guaranteed by the Emperor of Brazil, and under the editorial charge of his most able assistant and colleague, Dr. Eichler, this great work may be expected to reach an early completion, and to form a noble monument to the memory of Von Martius, although he himself elaborated only two or three of the families. He took laborious oversight of the whole, and wrote the various subsidiary articles, *Excursus, &c.*, especially those upon the medicinal and economical uses of Brazilian plants, and upon the aspects and characteristics of vegetation in different parts of the empire. These dissertations are written in choice Latin, and with a vigor and spirit which, it has been said, inspire regret for the olden time, when this was the universal language of botany. His fondness for linguistic studies, also, led him to investigate the languages of the tribes among which he travelled, and to collect vocabularies. He gave new attention to this subject in his later years, and in 1867 brought out his important, and, as it proved, his last work, the *Beiträge zur Ethnographie und Sprachenkunde Amerikas, zumal Brasiliens*, in two octavo volumes.

He wrote a separate treatise upon the medical properties of the plants of Brazil. He was a copious contributor to the *Gelehrte Anzeigen*, of Munich, during the whole period of its existence. In addition to his onerous duties as Professor of Botany in the University, and Director of the Botanic Garden, he was for many years, and down to his death, the active Secretary of the Mathematico-physical section of the Royal Bavarian Academy; and in that capacity he delivered a series of eulogies upon distinguished deceased members, which, recently reprinted in two octavo volumes, form a collection which may well compare with the similar and celebrated orations of Cuvier. These discourses, ranging, as they do, over wide fields in science and philosophy, exuberant in learning, discursive and yet profound, and often aglow with feeling, may give to those who knew him not some idea of the man himself, — of his wealth of knowledge and nobleness of spirit, his affectionate disposition, vivacity, geniality, and the fervid poetical imagination, which was rather tempered than restrained by the discipline of science and the experience of life. All appropriate honors and distinctions testified to his worth and the value of his scientific services. These culminated upon the fiftieth and jubilee anniversary of his doctorate, on the 30th of March, 1864, when his numerous friends and admirers of all parts of the world united to do him honor. Among the many offerings of that day was a large gold medal which his friends had caused to be struck, with the inscription, "*Palmarum patri dant lustra decem tibi palmam. In palmis resurges.*" But the infirmities of age were coming on. Yet another *lustrum* was almost filled with not unequal scientific labors, when, after short suffering, came the final rest; and, as the year 1868 drew near its close, the bier of Martius was decked with palms,—*souvenirs* of his greatest scientific achievement, and with which his name is imperishably associated.

Henry Hart Milman,* Dean of St. Paul's, was born in 1791, and died in October, 1868, at the age of 77. It would be difficult to name among Englishmen of the present century a more pleasing instance of devotion to letters than that of this eminent man. His early life was marked by academic distinctions. He gained an honorable reputation as a poet; and through his long career his scholarship revealed itself in various occasional contributions to the literature of the time. But he is best known by a series of historical writings, which covered from first to last some thirty years of his life.

His "History of the Jews," published in 1830 in the Family Library, seemed too bold to the public of that day, and it brought some censure upon his head. This he bore with silent patience, and outlived it. When after the lapse of a generation he reissued the book, with additions but without compromise, it was received in a different spirit. Next he appeared as the author of a "History of Christianity to the Extinction of Paganism in the Roman Empire." His third and most extensive work, the "History of Latin Christianity," was a continuation of this. It comes down to the point at which Gibbon's "Decline and Fall" terminates, but is written with a different purpose and in another vein. Dean Milman's previous diligent editorship of Gibbon had doubtless helped to train him to his undertaking. Gibbon had not professed to write a history of the middle ages; and Hallam had not exhausted the subject. Indeed, a modern layman could hardly bring to the history of the mediæval Church all the sympathy of a clerical scholar. But Milman's work, though the point of view is ecclesiastical, is not a mere priestly survey. The mediæval Church was an ever-present social force; and its chief men were in a multitude of cases the chief men of their time. The great poet of the middle ages worked in realms from which the Church drew its sanctions and its terrors, and in a certain sense is almost a Church figure. Thus the history of Latin Christianity is in large measure the history of Western Christendom. Dean Milman was awake to the greatness of his theme; and has made a very valuable addition to general history. The calm, mild, and genial spirit of the man appears in all his writings. But though, without gall, he was not without nerve. He could take with courage, and hold with steadiness, the difficult middle ground between obstinate assertion and obstinate denial. He stood clear of the dogmatism of the right and the dogmatism of the left. His tone has been characterized as that of "elegant neutrality." Certainly his turn was not partisan or polemic; yet he had not only a cultivated mind, but heart and will. A certain want of passion and fire, it is true, may now and then obstruct or slacken the flow of his narrative; and his historical style sometimes fails in the rhythm that might be expected from a poet's hand.

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* Omitted in the enumeration of deceased members on page 122.

His latest book was a labor of love. The famous Cathedral of which for many years he had the leading care was an object of his warm affection. He cherished its history, sought to increase its benefits, and strove to perfect its structure. The best and most characteristic token of his faithful regard is the interesting volume in which he has written its "Annals." The ripe knowledge and amiable temper of the old man give a sunset glow to the record. By those who knew him he will long be kindly remembered, not only for his attainments, but also for his qualities.

Six hundred and eleventh Meeting.

September 25, 1869. — MONTHLY MEETING.

The VICE-PRESIDENT in the chair.

Professor H. R. Storer read a paper on the origin of double monsters in the human species.

Six hundred and twelfth Meeting.

October 12, 1869. — MONTHLY MEETING.

The CORRESPONDING SECRETARY in the chair.

On the motion of Professor B. Peirce it was *voted*, That the mathematical section of the Academy be authorized to meet as a committee and receive mathematical communications; and a meeting of this committee was appointed for Tuesday, October 19, at four o'clock, P. M.

Professor Peirce made a communication on his investigations in Linear Algebra.

Six hundred and thirteenth Meeting.

November 10, 1869. — STATUTE MEETING.

The CORRESPONDING SECRETARY in the chair.

Dr. Jarvis made a communication on the coming decennial census of the United States.

The following committee was appointed to consider and report upon this subject; viz. Dr. Jarvis, Professor Peabody, and Professor Washburn.

The following gentlemen were elected members of the Academy: —

Thomas W. Parsons, of Boston, to be a Resident Fellow in Class III., Section 4.

James M. Barnard, of Boston, to be a Resident Fellow in Class II., Section 3.

Henry L. Whiting, of Boston, to be a Resident Fellow in Class I., Section 2.

Professor Nathaniel Southgate Shaler, of Cambridge, to be a Resident Fellow in Class II., Section 1.

Six hundred and fourteenth Meeting.

December 14, 1869. — MONTHLY MEETING.

The PRESIDENT in the chair.

Letters were read from James M. Barnard and N. S. Shaler, in acknowledgment of their election into the Academy. Also letters relative to the exchanges of the Academy.

Dr. M. Wyman, from the Rumford Committee, reported that the Rumford Medal, voted at the Annual Meeting to Mr. George H. Corliss, was ready for presentation. It was ordered that the presentation be made at the next meeting.

Dr. Jarvis, from the committee appointed at the preceding meeting relative to the ensuing census, made a detailed report, closing with a proposal to present the following memorial to Congress, which was adopted: —

To the Honorable the Senate and House of Representatives in Congress assembled: —

The American Academy of Arts and Sciences respectfully represents, in view of the great importance of a full and accurate enumeration of the people and of the light which it may throw upon the law of population, that the plan proposed by the Committee of the House of Representatives, to whom this matter was referred, is well adapted to their purpose, and they respectfully request that the plan of the Committee (including the prior schedules with the several inquiries in regard to population and the independent corps of enumeration) be adopted for the next enumeration of the people.

Adopted at a meeting of the Academy upon report of a Special Committee, December 14, 1869.

Six hundred and fifteenth Meeting.

January 11, 1870. — MONTHLY MEETING.

The PRESIDENT in the chair.

Professor J. Wyman made a communication on the power of the movement of the vibratory cilia on the tongue of a frog, and illustrated it by experiments with some simple machinery he had devised.

Dr. George E. Ellis made a communication on the genius and character of Count Rumford, and on the history of his endowment in the charge of the Academy.

The President then presented the Rumford Medal to Mr. Corliss with the following address: —

Gentlemen of the Academy, —At the last anniversary meeting, after a careful investigation by your appropriate committee, you awarded the Rumford Medal to Mr. George H. Corliss, for improvements of the steam-engine. The gold medal and a silver duplicate have been struck, and are now before us. The inventor whose genius you have thus recognized has responded to our call, and is now present. If it be your pleasure, these medals will now be consigned to his hands.

Mr. Corliss, — The trust which our countryman, Count Rumford, charged this Academy to administer, empowered it to award these medals "to the author of any important discovery or useful improvement on light or on heat, which shall have been made and published by printing, or in any way made known to the public, in any part of the continent of America or of any of the American islands; preference being always given to such discoveries as shall, in the opinion of the Academy, tend most to promote the good of mankind."

As this is only the fifth occasion since the foundation of the trust upon which this premium has been given, it may well be inferred that the Academy has in no case bestowed it inconsiderately.

It has required the discovery or invention to be real, original, and important. It is not restricted to considerations of direct practical benefit, but it may, as it did in the first instance, in the case of the oxyhydrogen blow-pipe, honor a discovery of much scientific interest, the uses of which are limited. It would not hesitate to crown any successful, however recondite or theoretical, investigation within the assigned domain, being confident that no considerable increase of our knowledge of the laws and forces of nature is likely to remain unfruitful. But the Academy rejoices when, as now, it can signalize an invention which unequivocally tends to promote that which the founder had most at heart, and commended to our particular regard, — the material good of mankind.

Without entering into details, it will be possible to state the ground upon which the present award has been made. It is for the effectual abolition of the throttle valve of the steam-engine, and the transferrence of the regulation by the governor to a system of induction valves of your own invention; with the advantage of a large saving in fuel, and — what is often more important in manufacturing industry — the maintenance of perfectly uniform motion under varying work.

Previous to your improvements, the regulation of the power and velocity of the steam-engine was effected by an instrument placed in the steam-pipe, well named the throttle valve; being used to choke off the steam in its passage from the boiler, to reduce more or less its pressure before it was allowed to act within the engine. Avoiding this wasteful process, your engine embodies within itself a principle by which it appropriates the full, direct, and expansive force of the *steam, and measures out for itself at each stroke, with the utmost precision*, the exact quantity necessary to maintain the power required. In the most approved engines previously used for manufacturing purposes, the valves employed were comparatively difficult to operate, too far from the piston, and in other respects unfit for working in connection with the governor. Their abandonment, and the substitution of others suitable for the purpose that you had in view, demanded an entire change in the structure of the engine.

In the reconstruction your mastery of the resources of mechanism is conspicuously shown. You introduced four valves to the cylinder, — two for the induction and two for the eduction of the steam; and by your device of a wrist-plate you give to each valve a rapid motion in opening and closing, and a slow motion after the closing has been effected, thus securing a perfection in valve-movements never before attained. The special object of these changes, and the *gist* of your invention, was to place the induction valves under the control of the governor, by which they are operated in opening through a mechanism from which they are released earlier or later in the stroke of the piston, according as more or less power is demanded of the engine, — the governor, with extreme sensibility, determining the point where the supply of steam should be cut off. Thus, at every stroke of the piston, just so much steam is accurately meted out to the cylinder as is needed to maintain uniform velocity, and left to expand there, and by its expansion develop the maximum of propelling force.

Allow me to read to the Academy a brief account of the Corliss engine, by one of the most eminent of British engineers, Mr. J. Scott Russell, which must needs be free from personal or national prepossession. It is from one of the official reports on the Paris Universal Exhibition of 1867.

"A third remarkable engine is American, both in invention and execution, and forms perhaps the most remarkable feature of the American department. It exhibits thoughtful design, ingenious contrivance, refined skill, and admirable execution. It is singularly unlike an English engine. It has four ports on four different parts of the cylinder, two on one side and two on the opposite, each worked by a separate mechanism. These ports are worked by valves, not sliding, like our own, on flat surfaces, but sliding valves on cylindrical surfaces. Close up to the cylinder these valves cut off the steam with scarce a particle of waste room, and so economize to the utmost the high-pressure steam which they admit, and which they use as expansively and as sparingly as possible. The mechanism by which these valves are moved is to our eye outlandish and extraordinary; but it is, in truth, refined, elegant, most effectual and judicious; it spares steam to the utmost, but develops what it uses to most effect. Then it proportions in an admirable way the doses of steam it serves out to the continually varying quantity of work the engine has to do. The mechanism of its mechanical governor is wonderfully delicate and direct; the governor is sensitive to the most delicate changes of speed, and feels the slightest demand upon the engine for more or less work and steady speed. A mechanism as beautiful as the human hand releases or retains its grasp of the feeding valve, and gives a greater or less dose of steam in nice proportion to each varying want. The American engine of Corliss everywhere tells of wise forethought, judicious proportion, sound execution, and exquisite contrivance."

It appears that within the twenty years since this machinery was perfected, more than one thousand engines of the kind have been built in the United States, and several hundreds in other countries, giving an aggregate of not less than 250,000 horse-power; that, as to economy of fuel, evidence has been afforded to the Rumford Committee, showing a saving over older forms of engine of about one third. As to its other crowning excellence, — uniformity of velocity, — the purchasers of one of the engines, now in its eighteenth year of service, certify that, with the power varying from 60 to 360 horse-power within a minute, the speed of the engine is not perceptibly affected.

It is worth noting, that when these medals were voted to you, Mr. Corliss, just a century had passed since James Watt first patented his improvements of the steam-engine. The vast results of these improvements — the difference between the engine when Watt found it and when he left it — make one of the most important chapters in the history of applied science. It is a great thing to say, but I may not withhold the statement, that, in the opinion of those who have officially investigated the matter, no one invention since Watt's time has so enhanced the efficiency of the steam-engine as this for which the Rumford Medal is now presented to you. If Watt, or his partner, Bolton, could boast that they held the supply of that which almost everybody longed to have, *power*, you may justly felicitate yourself, and permit us to felicitate you, upon your ability to supply a greater amount of steam power for the expenditure, and an exacter nicety in its governance, than any of your predecessors.

In acknowledgment of this benefit, the American Academy, administering Count Rumford's trust, now, by the hands of its presiding officer, presents to you these honorable testimonials of its high appreciation of what you have done. And the Fellows here assembled join with me, I am sure, in most sincere and hearty wishes that you may long enjoy this and similar distinctions, as well as more material rewards of your genius and skill, — hoping also that these may still be fruitful in yet other inventions, redounding to your honor and advantage and to the promotion of the good of mankind.

Mr. Corliss accepted the medals, and replied as follows: —

MR. PRESIDENT, — Competitive honors are the reward of effort, stimulated by rivalry and ambition. This honor comes from gentlemen who scan the whole field of science and art, and in deliberate council make their awards in discharge of a sacred trust. To this consideration I add the historical associations connected with the American Academy of Arts and Sciences, and the scientific fame of its members; and I receive this testimonial with grateful acknowledgment of a distinguished honor.

Six hundred and sixteenth Meeting.

January 26, 1870. — STATUTE MEETING.

The PRESIDENT in the chair.

The President announced to the Academy the decease, during the past season, of two members; viz. of Thomas Graham, a Foreign Honorary Member; and of Thomas Sherwin, of the Resident Fellows.

Professor Lovering made a communication on the theory of halos, and described the remarkable halo observed by him on the afternoon of January 6th, inst.

The President presented the following paper: —

A Revision of the Eriogoneæ, by John Torrey *and* Asa Gray.

This group was first put in order and characterized as a tribe of *Polygonaceæ* by Mr. Bentham, in his monograph read to the Linnean Society almost thirty-five years ago, and was re-elaborated by him about eighteen years ago for the fourteenth volume of De Candolle's Prodromus, which, however, was not published until the year 1856. In the first monograph there were 40 species described under three genera. In the Prodromus, where the group ranks as a sub-order, 105 species are described under seven genera. Including *Lastarriæa*, which Mr. Bentham did not recognize from its having no involucre, there are 106 species and eight genera, — all the genera except the last, and all the species but ten, being natives of North America.

Being thus wholly American, mainly North American, and especially characteristic of our drier Western regions, we are naturally interested in these plants. To one of us they have long been a favorite study, as the current botanical works, from the Account of the Collection made by Dr. Edwin James in 1826, down to the fourteenth volume of the Prodromus and the Botany of the Mexican Boundary, sufficiently show. The other, the present writer, in the autumn of 1868 critically collated his own collection (recently and specially enriched by most of Nuttall's species, generously presented by Mr. Durand) with the herbaria of Hooker and Bentham, now of the great collection at Kew, and with Mr. Nuttall's proper herbarium, now belonging to the British Museum; and on his return he has, with his partner's specimens, notes, and sketches to aid him, re-examined the whole, and embodied the results in the present memoir.

The genera here recognized are seven; one of Bentham's (*Mucronea*) being suppressed, and *Lastarriæa* admitted. If the species are only slightly increased, viz. from 105 to 115 (counting the omitted Chilian *Chorizanthes*), this is mainly due to the suppression of several of the older species, especially in *Eriogonum*, which here amount to no more than in the Prodromus, although 19 have actually been added.

Clavis Generum.

1. Involucrum immutatum, fere semper calyciforme, raro nullum.
(Folia integerrima.) . . . . . Tribus I. EUERIOGONEÆ.

Vix genuinum, 3-4-phyllum, nempe flores in capitulum digesti bracteis dilatatis fulcrati, quarum 3-4 extimæ vacuæ involucrum referentes. . . . . 1. NEMACAULIS.
Genuinum, gamophyllum (perigonium sæpissime corollinum),
  Multi-pauciflorum, pedicellis exsertis cum flore articulatis basi tenuiter bracteolatis.
    Dentibus lobisve muticis: achenium triquetrum. . 2. ERIOGONUM.
    Lobis (4) aristatis, tubo nudo: achenium lenticulare. 3. OXYTHECA.
  Uni-triflorum, juxta basim 3-6-calcaratum. . . 4. CENTROSTEGIA.
  Uniflorum, inappendiculatum, flore subincluso pedicello sæpius brevi nunc subnullo articulato. . . . . . 5. CHORIZANTHE.
  Plane nullum: perigonium subcoriaceum involucrum *Chorizanthes* simulans, stamina ad faucem gerens. . . . 6. LASTARRIÆA.
2. Involucrum monophyllum bracteæforme, nempe e bractea tenui florem solitariumam plectente, fructifero reticulato dorso bigibberoso-saccato. Folia nunc lobata vel dentata.
Tribus II. PTEROSTEGIEÆ, & 7. PTEROSTEGIA.

1. NEMACAULIS, Nutt.

Flores *Eriogoni*, sed breviter pedicellati, in capitulum digesti, singuli bractea suffulti. Bracteæ herbaceæ, extus glaberrimæ, intus lana longa implexa alba vestitæ, exteriores 3-4 vacuæ rotundatæ, involucrum referentes, sequentes paullo longiores et gradatim decrescentes stipitatæ. Stamina 3.—Herba annua, foliis radicalibus vel subradicalibus spathulatis utrinque mollissime albo-lanatis, scapis filiformibus parce divaricato-dichotomis, capitulis parvis alaribus et secus ramos dissitis arcte sessilibus.

1. N. NUTTALLII, Benth. in DC. Prodr. 14, p. 23. *N. denudata & N. foliosa*, Nutt. Pl. Gamb. (Jour. Acad. Philad. n. ser. 1) p. 168. Sandy beach near San Diego, California, Nuttall, Cooper. Perigonium whitish-yellow, glabrous. This rare plant has much the habit of an *Eriogonum* of the *Virgata Annua* group, but the bracts are only to be compared with those of *E. angulosum*.

2. ERIOGONUM, Michx.

Involucrum multiflorum rariusve pauciflorum, rarissime uniflorum, campanulatum, turbinatum, vel cylindraceum, plerumque 5-8-dentatum seu lobatum, muticum. Flores cum pedicellis suis per anthesin ex involucro pl. m. exsertis articulati: bracteolæ sæpius tenerrimi vel angustissimæ. Perigonium 6-partitum seu profunde 6-fidum. Stamina 9. Achenium triquetrum, in paucis trialatum.—Herbæ vel suffrutices Americæ Borealis præcipue Occidentalis, paucæ ad terras adjacentes Mexicanas.

CLAVIS ERIOGONUM.

I. Achenium trialatum. Embryo axilis fere rectus. § 1. ALATA.

Flores plus minus pubescentes. Achenium supra medium trialatum. Panicula floribunda. . . . . . . 1. *E. hieracifolium.*

Flores glaberrimi. Achenium a basi ad apicem alatum. Panicula floribunda: flores flavescentes. . . . . . 2. *alatum.*

Pedunculi pauci longissimi: flores rubentes. . . . . 3. *atrorubens.*

II. Achenium exalatum.

Flores villosi, basi abrupte longeque quasi in stipitem producti. Embryo rectus axilis. Caules foliati. Involucra nec umbellata nec capitata. . . . . § 2. ERIANTHA.

Folia secus caulem elatum alterna, angusta: panicula nuda: perigonia herbacea. . . . . 4. *longifolium.*

Folia caulina verticillata: involucra in cyma dichotoma foliata sessilia: perigonia alba.

Bi–tripedale, herbaceum, foliosum, foliis obovatis ovalibusque planis. . . . . 5. *tomentosum.*

Humile, fruticulosum, foliis ovatis undulatis. . . . . 6. *undulatum.*

Humile e caudice sublignoso, foliis caulinis spathulatis oblongisve. . . . . 7. *Jamesii.*

Flores basi quasi in stipitem cum pedicello articulatum producti. Involucra umbellata, nunc capitata vel in pedunculo nudo solitaria. Perennia, sæpe fruticosa. . . . . § 3. UMBELLATA.

Perigonium extus villoso-sericeum, aureum: umbella completa: embryo rectus. . . . . . . 8. *flavum.*

Perigonium extus villosum seu pubescens: involucra subumbellata vel solitaria: embryo excentricus sæpe incurvus.

Involucrum breviter lobatum: perigonium basi retrorsum villosissimum. Rami erecti foliosissimi. . . . 9. *thymoides.*

Involucrum profunde 6 – 8-fidum, lobis demum reflexis.

Acaule, scapo 1 – 4-pollicari aphyllo uni-involucrifero. . . . . 10. *cæspitosum.*

Subacaule, scapo medio verticillo unico foliorum instructo sæpius uni-involucrifero. . . . . . 11. *Douglasii.*

Caulescens, ramis floridis foliatis, pedunculis brevibus. . . . . 12. *sphærocephalum.*

Perigonium extus glaberrimum, basi stipitiformi gracili.

Tota planta glaberrima præter filamenta basi villosa. Flores pro genere magni. . . . . . . 13. *Torreyanum.*

Lanata vel araneosa, nunc glabrata. Flores mediocres in involucro 5 – 9-fido.

Caules floridi adsurgentes pl. m. foliati et ramosi, pedunculis solitariis vel paucis umbellatis terminati. . 14. *polyanthum.*

Caules floridi seu pedunculi scapiformes, aphylli, seu verticillo unico rarius duo foliorum instructi: umbella sæpius perfecta, simplex vel composita.

Umbella composita pleniradiata in scapo valido sub-sesquipedali nudo, bracteis linearibus seu lanceolatis involucrantibus subtensa: flores albidi: folia radicalia oblongo-ovata seu cordata. . 15. ***compositum.***

Umbella simplex vel composita in ramis floridis 1–2-pedalibus sæpissime medio verticillo foliorum instructis: flores pallide lutei, stipite gracillimo: folia spathulato-oblonga seu lineari-lanceolata. 16. *heracleoides.*

Umbella simplex, raro subcomposita, nunc ad involucrum unicum vel 2–4 capitata reducta, in scapo (spithamæo ad pedalem) præter bracteas verticillatas involucrantes aphyllo.

Involucra subæqualiter pedicellata: folia obovata, spathulata, seu ovalia. . . . . . . 17. *umbellatum.*

Involucrum in umbella centrali semper sessile: scapus nudus gracilis.

Laxe cæspitosum, foliis parvis ovatis longe petiolatis: flores lutei. . . . . 18. *marifolium.*

Dense cæspitosum, foliis oblongis spathulatisve brevius petiolatis utrinque canis: flores flavi. 19. *incanum.*

Flores basi abrupte constricta brevissima cum pedicello articulati, haud flavi. Involucra umbellata ut in § 3. Perigonii segmenta conformia. Ovarium totum vel basi glabrum. Perennia. . . . § 4. Pseudo-Umbellata.

Ovarium supra medium et perigonium extus inferne laxe villosum: folia obovata seu ovata. . . . . . . 20. *pyrolæfolium.*

Ovarium glaberrimum: perigonium subglabrum: folia sublanceolata. . . . . 21. *androsaceum.*

Ovarium et perigonium glaberrimum: folia subrotunda. . . . . 22. *Lobbii.*

Flores basi lata haud producta ipsa cum pedicello articulati, extus lanati. Ovarium lanosissimum! Involucra pauca, capitata vel subcymosa. . . . . § 5. Lachnogyna.

Pulvinato-cæspitosum: involucra 1–5 intra folia suprema confertissima lineari-oblonga subsessilia. . . . 23. *acaule.*

Scaposum: involucra subcymosa: folia radicalia, lanceolata, sericea. . . . . 24. *lachnogynum.*

Flores basi ipsa haud producta cum pedicello articulati. Ovarium glabrum vel glabellum. Embryo incurvus vel incurvo-excentricus, radicula elongata.

Involucra capitata vel umbellato-cymosa in scapo simplicissimo nudo: perigonii glaberrimi (rosei seu albi) segmenta maxime disparia; exteriora aucta rotundata; interiora angusta spathulata, conniventia. Herbæ perennes. . . . . § 6. Heterosepala.

Umbella prolifero-composita: segmenta exteriora perigonii vix cordata. . . . . 25. *proliferum.*

Capitulum simplex ex involucris paucis: segmenta exteriora perigonii mox cordata. . . . . . 26. *ovalifolium.*

- **Involucra capitata:** capitulum globosum solitarium, nunc pauca umbellata, in scapo nudo simplici: segmenta perigonii fere semper glabri consimilia. Herbæ perennes. . . . . § 7. CAPITATA.
  - Cæspitosæ, pumilæ, monocephalæ, scapo simplicissimo: flores in involucris paucis 5 – 7-dentatis vix numerosi,
    - Lutei vel rosei, segmentis obovatis subcuneatis emarginatis: folia obovata vel spathulata, albido-lanata. . 27. *Kingii.*
    - Albi seu fusco-flavidi, extus sublanulosi: folia angusto-spathulata seu lanceolata, niveo-lanata. . . 28. *multiceps.*
    - Albi, glabri, segmentis ovalibus: folia linearia v. subspathulata, glabrescentia. . . . . . . 29. *pauciflorum.*
  - Subcaulescentes, proceræ, mono–oligocephalæ: involucra truncata multiflora.
    - Capitula magna in pedunculo 1 – 2-pedali: folia ovalia sæpius cordata: perigonii albi segmenta lato-obovata. 30. *latifolium.*
    - Capitula majuscula in pedunculo 6 – 12-pollicari: segmenta perigonii oblongo-obovata. . . . . . 31. *oblongifolium.*
- **Involucra capitellata,** sæpius terna vel gemina, alaria nunc solitaria, truncata, subdentata, pluriflora: capitula paniculato-cymosa in scapis 1 – 3-pedalibus nudis: perigonii (glabri seu villosuli) segmenta fere æqualia. Herbæ perennes. . . . . § 8. CAPITELLATA.
  - Folia subtus cano-tomentosa: involucra cylindraceo-campanulata ore truncato, alaria sessilia. . . . . . 32. *nudum.*
  - Folia villoso-pubescentia: involucra subturbinata repando-dentata, alaria sæpe pedicellata, cætera subglomerata. 33. *elatum.*
- **Involucra in capitula cymulasve capituliformes glomerata,** multiflora, capitulis bracteatis cymoso-umbellatis. Suffrutices foliosi, foliis parvulis alternis et in axillis fasciculatis. . . . . . . § 9. FASCICULATA.
  - Flores extus sericeo-villosi: folia ovata, parum fasciculata: pedunculi junciformes nudi. . . . . . 34. *cinereum.*
  - Flores glabri: folia ovata vel sublanceolata: pedunculi 2 – 3-chotomi folioso-bracteati. . . . . . . 35. *parvifolium.*
  - Flores glabri vel puberuli: folia parva, lineari-spathulata seu oblonga, margine revoluta: pedunculo nudo elongato. 36. *fasciculatum.*
- **Involucra aperte cymosa,** pedunculo nudo apice umbellatim diviso, radiis repetite 2 – 3-chotome in cymam corymbiformem subdivisis. Caules inferne seu basi foliosi, foliis alternis angustis. Perigonium extus semper glabrum. . . . . § 10. CORYMBOSA.
  - Fruticuli ramis adsurgentibus foliosis: perigonii segmenta subsimilia.
    - Pumilum, foliosissimum: folia parva ob margines arcte revoluta teretia: cyma parva. . . . . 37. *ericæfolium.*
    - Sesqui–bipedale, alte foliosum: folia oblonga: cyma late corymbosa floribunda. . . . . . . 38. *corymbosum.*
    - Humilius, a basi ramosissimum: folia oblonga seu linearia. . . . . 39. *microthecum.*
  - Subherbacea perennia, ramis foliatis brevissimis vel cæspitoso-depressis pedunculum scapiformem proferentibus: perigonii segmenta subæqualia: folia linearia, spathulato-lanceolata, etc., in petiolum attenuata.

Humile, foliis in ramis caudiciformibus confertissimis, scapis rigidis. . . . . 40. *brevicaule.*
Ultrapedale, cyma laxa paniculæformi, foliis sparsis. . . . . 41. *lonchophyllum.*
Herbæ annuæ : caulis erectus,
Laxe ramosus, inferne tantum foliatus : involucrum truncatum : perigonium roseum, intus glabrum : segmentis consimilibus obovatis. . . . . 42. *truncatum.*
Strictus, elatus, sursum longe foliatus : cyma decomposita floribunda : perigonium album, fundo arachnoideo-lanatum : segmentis exterioribus multo majoribus,
Late obovatis, interioribus oblongis : folia caulina basi attenuata. . . . . 43. *annuum.*
Orbiculato-cordatis, interioribus sublinearibus : folia caulina basi obtusa vel auriculata. . . . . 44. *multiflorum.*
Involucra sessilia secus ramos paniculæ virgatos sæpius unilateraliter solitarie disposita, parva vel angusta. . . § 11. VIRGATA.
Herbæ perennes, nunc basi suffruticosi : flores glabri (albi vel subrosei) in involucro plures,
Basi lata quasi truncati, ob segmenta exteriora dilatata post anthesin marginibus usque ad basim ipsam discretis subauriculato-rotundatis. Niveo-lanatum.
Bracteæ cum dentibus 3 – 4 involucri recurvo-patentes : perigonii segmenta ext. orbiculata subcordulata. 45. *niveum.*
Bracteæ appressæ : pedunculus scapiformis : perigonii segmenta exteriora ovali-obovata. . . . . 46. *dichotomum.*
Basi acutum : segmenta consimilia.
Acaulescens, scapo gracillimo 2 – 3-chotome ramoso fere glabro : folia in petiolum longe angustata. . 47. *strictum.*
Acaulescens, nunc inferne 1 – 2-foliatum, scapo valido, involucris secus ramos paucos rigidos spicatis : folia basi abrupta vel subcordata. . . . . 48. *racemosum.*
Caulescens, inferne foliosum, diffuso-paniculatum. . . . . 49. *Wrightii.*
Herbæ annuæ, spec. prima excepta ? Flores parvi, albi vel rosei.
Involucra tubulosa, lin. $3\frac{1}{4}$ – 2 longa, pluriflora, albo-lanata, secus ramos virgatos sæpe simplices dissita.
Sesqui–tripedale, simplex, nudum : folia oblongo-lanceolata : involucra remota usque ad lin. 3 longa, ore repando-truncato. . . . . 50. *elongatum.*
Semi–bipedale, nunc ramosum : folia ovata seu oblonga : involucra usque ad $2\frac{1}{2}$ lin. longa, ore 5-dentato. 51. *virgatum.*
Involucra angusta tubulosa, haud ultra lin. 2 longa, pauci–pluriflora, secus ramulos tenues paniculæ diffusæ amplæ dissita. Folia radicalia rotundata.
Subpedale, flocculoso-cinereum v. superne glabratum : perigonium extus plus minus villosum. . . 52. *dasyanthum.*

Spithamæum ad pedalem; involucra sparsa cum panicula et perigonia glabra. . . . . . 53. *vimineum.*

Involucra oblongo-campanulata v. subturbinata, lineam longa, secus ramulos tenues paniculæ ramosissimæ dissita vel sparsa. Perigonium involucro brevius. Folia ovata seu oblonga.

Panicula effuso-patens: bracteolæ in involucro vix barbellatæ: perigonii segmenta exteriora obovata, interiora oblonga. . . . . 54. *gracile.*

Panicula in caule 2–3-pedali foliosa ampla strictiuscula: bracteolæ longe parceque villosæ: perigonii segmenta basi attenuata, exteriora flabellato-cuneata, interiora obovato-spathulata. . . 55. *polycladon.*

Involucra brevi-campanulata, parva, pauciflora, perigoniis post anthesin auctis breviora, secus ramulos plerumque intricatos paniculæ nudæ sparsa. Folia omnia subradicalia, subrotunda.

Glaberrimum vel glabratum: perigonia glabra, fructifera lin. 2 longa, segmentis exterioribus rotundatis, interioribus parvis oblongo-spathulatis. . . . . 56. *Heermanni.*

Floccoso-lanatum, humile: perigonia glabra, lineam longa, segmentis conformibus quasi panduriformibus. 57. *Plumatella.*

Glabrum v. viscoso-pubens, divaricato-ramosissimum: perigonia parce hirtella, minima, segmentis obovatis conformibus. . . . . 58. *intricatum.*

Involucra omnia pedicellata, laxe paniculata in ramis scapi seu pedunculi scapiformis prorsus aphylli. Præter folia plerumque radicalia rotundata sæpissime glabrum. . . . . § 12. PEDUNCULATA.

Herbæ annuæ, panicula divaricato-ramosissima glandulis claviformibus obsita.

Pedicelli involucro glanduloso 8–12-floro haud longiores: perigonii glabri segmenta disparia. . . . . 59. *brachypodum.*

Pedicelli capillares involucro perpaucifloro multoties longiores: perigonii hirsutuli segmenta subæqualia. . 60. *glandulosum.*

Herbæ annuæ, eglandulosæ vel pedicellis raro minutissime viscoso-glandulosis.

Pedicelli paniculæ effuso-ramosissimæ floribundæ rigidi mox deflexi,

Involucro brevi breviores: perigonii albi segmenta exteriora cordato-rotunda, interiora minima. . . 61. *deflexum.*

Involucro late campanulato 2–3-plo longiores, viscosi: perigonii rosei basi obtusissima, segmenta exteriora late ovalia emarginata, interiora oblonga dimidio minora. . . . . . 62. *nutans.*

Involucro angusto vel clavato-campanulato 2–5-plo longiores, læves: perigonii albo-rosei basi obtusa, segmenta fere æqualia, ovalia, parum retusa. . . . . 63. *Watsonii.*

Involucro campanulato 2–4-plo longiores, læves: perigonii albi vel subrosei basi turbinata acuta, segmenta exteriora quadrata emarginata, interiora oblonga dimidio angustiora. . . . 64. *cernuum.*

Pedicelli paniculæ effusæ sæpius ramosissimæ nunquam deflexi,
- **Rigiduli**, breves : perigonium album, 6-fidum, segmentis maxime disparibus, exterioribus flabelliformi-dilatatis : panicula rigida. . . . . 65. *rotundifolium.*
- **Tenues** seu capillares, elongati.
  - **Tenellæ**, 3 – 9-pollicares, foliis subtus vel utrinque albo-lanatis : perigonia subglabra, fructifera involucro haud longiora.
    - Perigonium album, segmentis panduratis, exterioribus sursum valde rotundato-dilatatis, interioribus parvis angustis. . . . . 66. *Thurberi.*
    - Perigonium album vel flavidum, parvum, basi tenuiter hispidulum, segmentis subpanduratis apice parum dilatatis æquilongis, exterioribus basi latiore, interioribus dimidio angustioribus. . 67. *Thomasii.*
    - Perigonium aureum, extus subglanduloso-puberulum, segmentis subconformibus obovatis. . 68. *pusillum.*
    - Perigonium album vel subroseum, glabrum, segmentis conformibus ovatis. . . . . . . 69. *reniforme.*
  - **Elatiores**, scapo sæpius fistuloso vel inflato, foliis pubescentibus nunquam lanatis : perigonia involucro minimo atque paucifloro longiora, flavula, extus hirsuta, segmentis conformibus : pedicelli tenuissimi.
    - Folia tenuiter pubescentia vel glabrata, vix cordata : scapus brevis haud inflatus, in paniculam ramosissimam solutus. . . . . 70. *trichopodum.*
    - Folia hirsutiora seu velutina : scapus elongatus superne fusiformi-inflatus. . . . . . 71. *inflatum.*
  - **Nudæ**, foliis floribusque etiam glabris, pedicellis prælongis erectis. . . . . 72. *Gordoni.*

Herbæ perennes seu biennes ? minus ramosæ, pedicellis elongatis erectis cum involucris pluri–multifloris ultra sesquilinearibus lævibus.
- **Caudex** suffruticosus ramive breves foliosissimi : folia ovata seu rotunda, petiolata, utrinque albo-tomentosa : panicula floribunda : flores in involucro pauciores, albi. . . . . 73. *tenellum.*
- **Radix** biennis seu annua : folia obovato-spathulata, ciliata, glabrata : scapus oligocephalus : involucrum multiflorum : flores rubentes. . . . . 74. *ciliatum.*

Involucra pedicellata (raro alaria sessilia) et paniculata vel sparsa in caulibus foliosis sæpius ramosis : folia plerumque opposita seu verticillata.

Folia caulina vera semper parva stipulæformia, axillaria magis evoluta gemina vel fasciculata fulcrantia.
Perigonium extus minute glandulosum. . . . . § 13. PSEUDO-STIPULATA.
Floccosum, annuum: panicula effusa: pedicelli filiformes: involucra multiflora 5-dentata: perigonium segmentis disparibus. . . . . 75. *angulosum.*
Puberulum, perenne: pedicelli subracemosi erecti: involucra multiflora 5-dentata: perigonium segmentis conformibus. . . . . 76. *Greggii.*
Minute pubescens, annuum, divaricato-ramosissimum: involucra minima, 5-partita, pauciflora, alaria sæpius sessilia. . . . . 77. *divaricatum.*
Folia caulina rite evoluta sæpius cum axillaribus consimilibus fasciculatis, ... § 14. FOLIOSA.
Spathulata seu linearia, subcarnosa, glabra: involucra pluripartita, pauciflora, alaria arcte sessilia: perigonium subherbaceum, fructiferum achenio acutissime triquetro conforme. . . . 78. *salsuginosum.*
Ovata, subcordata, vel sublinearia, villoso-pubescens: involucra breviter seu longiuscule pedunculata, multiflora, 5 – 8-fida: perigonium petaloideum, segmentis disparibus, exterioribus profunde cordatis. . . . . 79. *Abertianum.*
Angustissime linearia: panicula effusa, tenuis, nuda, pedicellis capillaribus.
Involucrum 5 – 8-fidum, 8 – 12-florum: folia subtus cano-tomentosa. . . . . 80. *pharnaceoides.*
Involucrum 4-fidum, minimum, 1 – 2-florum: folia utrinque viridia. . . . . 81. *spergulinum.*

§ 1. Alata, Benth. Achenium trialatum. Embryo rectus seu rectiusculus, axilis. Flos basi haud productus, nempe perigonium 6-partitum basi lata ipsa cum pedicello articulatum. — Perennes seu biennes, caulibus scapiformibus 1 – 3-pedalibus, involucris sæpissime longius pedunculatis laxe cymoso-paniculatis, foliis radicalibus spathulatis seu lanceolatis, pube laxa.

* Flores pl. m. pubescentes, nempe perigonio extus adpresse pilosulo, filamentis basi et ovario superne parceque hirsutis. Panicula floribunda. Achenium supra medium trialatum.

1. E. hieracifolium, Benth. in DC. l. c. Planta Wrightiana, cinereo-pubescens; foliis radicalibus subtus subtomentosis supra costaque subtus laxe sericeo-villosis; floribus flavis. — Guadalupe Mountains, E. of El Paso, Texas, Wright.

Var. β. hemipterum. *E. hemipterum*, Torr. in herbariis. *E. hieracifolium*, Torr. Bot. Mex. Bound. p. 175, pro parte. Humilius; caule tenuiore magis foliato; pube tantum villosa parca; floribus ut videtur roseis. — Hillsides of the Rio Grande, Parry. The foliage of this is so different in pubescence from the type of the species (being just as in the next) that with other specimens it may prove to be a distinct species; but the flowers are the same except (apparently) in color.

* * Flores glaberrimi. Achenium a fere basi ad apicem alatum.

2. E. alatum, Torr. (Sitgreaves, Rep. t. 8), Benth. l. c. Elatum, floribundum; pube laxa hirsuto-villosa nunc parca vel ætate decidua; panicula decomposita; involucro 5-dentato; floribus parvis flavescentibus; alis fructus latiusculis tenuibus. — From the Platte to W. Texas and New Mexico, by various collectors. — Var. glabriusculum, Torr. Bot. Whippl. (on the upper Canadian, Bigelow), the most glabrate form, has only a few scattered hairs on the leaves, and the involucres are wholly glabrous.

3. E. atrorubens, Engelm. Pl. Wisl. p. 24. Foliis radicalibus villoso-pubescentibus basi in petiolum longe alatum attenuatis; scapo aphyllo? glabrato inferne pl. m. fistuloso-inflato in cymam laxam dichotomo-divisis; involucris paucis longe pedunculatis brevi-campanulatis 5 – 7-dentatis; perigonio rubente; alis fructus angustis incrassatis. — Cosihuiriachi, Mexico (Chihuahua), Wislizenus.

§ 2. Eriantha, Benth. excl. sp. Achenium exalatum, ut in omnibus subsequentibus. Embryo rectus, axilis, radicula cotyledonibus latis breviore. Flos extus villosus vel sericeus, basi subito quasi in stipitem cum pedicello articulatum longe productus. Perennia, caulibus foliatis ramosis, foliis aut alternis aut verticillatis subtus (nunc fulvo- sæpius cano-) tomentosis, involucris solitariis plerumque sessilibus.

* Folia angusta (lanceolata seu oblongo-linearia), inferiora in petiolum attenuata, omnia cum ramis inferioribus paniculæ apertæ nudæ alterna. Involucra subdissita, inferiora pl. m. pedunculata. Perigonia herbacea, segmentis consimilibus.

4. E. LONGIFOLIUM, Nutt. *E. Texanum*, Scheele in Linnæa. — Arkansas, Texas, and rare in Florida. Stems 2 – 4 feet high from a thickened root.

* * Folia caulina 3 – 5-natim verticillata, ovalia seu oblonga: cyma dichotoma, foliata, involucris in dichotomiis vel secus ramos sessilibus multifloris. Perigonia subpetaloidea, alba, segmentis 3 interioribus sæpius demum longioribus.

5. E. TOMENTOSUM, Michx. Fl. 1, p. 246, t. 24. Caulibus 2 – 3-pedalibus foliosis; foliis caulinis sessilibus obovatis seu ovalibus subtus tomento sæpissime fulvo vel rufo; perigonii segmentis late ovatis extus tomentosis margine lato albo, tubo pedicelliformi elongato. — Pine barrens from South Carolina to Florida; the original species, and, with the rare exception of the foregoing, the only one met with east of the Mississippi.

6. E. UNDULATUM, Benth. in DC. l. c. p. 7. Mexico, Née, Galeotti. Known only from imperfect specimens. Apparently dwarf and fruticulose, with much smaller flowers than in the foregoing; the leaves undulate-crisped.

7. E. JAMESII, Benth. l. c. *E. sericeum*, Torr., non Pursh. Caulibus 5 – 12-pollicaribus e caudicibus lignescentibus cæspitosis parce foliatis; foliis caulinis spathulatis oblongisve subsessilibus, tomento albido; involucri extus laxe villoso-sericei segmentis obovatis vel spathulatis. — From the Platte to W. Texas and New Mexico.

§ 3. UMBELLATA, Benth., excl. sp. pluribus. Flos (ut in § 2) inferne in basim angustam sæpissime quasi in stipitem cum pedicello articulatum productus! Involucra multiflora, nunc solitaria (raro pauca in capitulum), nunc in umbellam simplicem vel compositam pedunculum ramosve floriferos terminantes, collecta. Ovarium inferne glabrum, superne plerumque parce hirsutum. Embryo curvulus vel fere rectus; radicula breviuscula seu longiuscula, cotyledonibus pl. m. excentricis longiore vel æquilonga. — Herbæ perennes, *nunc suffrutescentes*, sæpissime humiles, foliis plerumque subtus præsertim albo-lanatis, raro glabratæ vel glabræ; floribus fere semper flavis vel luteolis nunc purpureo tinctis.

* Perigonium extus villosum seu pubescens.

+– Involucra repando-5–7-dentata, campanulata. Umbella sæpius pluriradiata, foliis involucrantibus subtensa. Embryo rectus, parum excentricus.

8. E. FLAVUM, Nutt. in Fraser, Cat. Pube sericeo-lanata canescens vel incanum; pedunculis scapiformibus (3–6-pollicaribus) e caudice crasso multicipiti; foliis spathulatis seu lanceolato-oblongis supra tardius glabratis, radicalibus in caudice confertis, involucrantibus 2–8 radios totidem subæquantibus; perigoniis aureis extus sericeo-villosis basi infundibuliformi substipitatim producta; ovario apice hirsuto. *E. sericeum*, Pursh. — Variat: 1. Foliis crassioribus lana subtus densiore. *E. crassifolium*, Benth. Eriog.; Hook. Fl. Bor.-Am. t. 176; the involucre represented too deeply toothed. 2. Foliis subovatis crassis supra glabratis subtus lana ferruginea. Crater Pass, Newberry. 3. Nanum; umbella in capitulum ex involucris 3–4 sessilibus nunc ad involucrum solitarium reducta. *E. aureum*, Nutt. in herb. 4. Vegetius, subpedale, umbella bis 3–4-radiata, radiis valde inæqualibus. — W. Kansas to Saskatchawan, Rocky Mountains, &c. Flowers three lines long. The embryo is straight, but with the cotyledons moderately excentric; these are nearly as broad as the albumen (as in all Umbellata), and shorter than the radicle, which is not perceptibly inflexed at the junction.

+– +– Involucra lobata, sæpius in pedunculo solitaria, nuda, nunc 2–3 in umbellam imperfectam 2–3-radiatam vel capitulum collecta. Embryo ubi observatus incurvo-excentricus.

++ Microphyllum: involucrum turbinatum, sublobatum, lobis dentibusve latis vix patentibus.

9. E. THYMOIDES, Benth. in DC. Suffruticosum, cæspitoso-ramosissimum (spithamæum), cinereo-tomentosum; ramis floridis inferne foliosissimis; pedunculo infra medium verticillo foliorum instructo; foliis (lin. 2–3 longis) lineari- seu oblongo-spathulatis margine revolutis; perigonio basi cyathiformi attenuata pilis creberrimis reflexis villosissimo. — N. branch of the Columbia, Wilkes's Ex. Expedition. Simcoe Hills in the same region, Dr. Lyall. A most distinct species: the flowers apparently pale yellow with some tinge of purple.

++ ++ Folia majora: involucrum profunde 6–8-fidum, lobis angustis patentibus demum reflexis.

10. E. CÆSPITOSUM, Nutt. in Jour. Acad. Philad. 7, p. 50, t. 8. Pulvinato-cæspitosum, foliis in ramis humifusis caudicium plerumque rosulatis spathulatis undique cano-tomentosis marginibus pl. m. revolutis (lin. 3–6 longis); scapo aphyllo 1–3-pollicari; involucro solitario; perigoniis luteis nunc purpureo tinctis extus sericeo-villosiusculis basi breviter stipitato-contractis, segmentis ovalibus, interioribus basi cum filamentis pilis longis pl. m. villosis; ovario versus apicem parce hirsutulo. *E. andinum,* Nutt. Pl. Gamb. p. 160, forma minore, ovario in pl. submasculis prorsus glabro. — Rocky Mountains, Nuttall, Fremont, &c. Mountains of Nevada, at 4,000 to 6,500 feet, Bloomer, Stretch, Torrey, S. Watson in C. King's Expedition. Flower two, or in age three lines long, including the stipitiform base.

11. E. DOUGLASII, Benth. in DC. Dense cano-lanatum; caudicibus suffrutescentibus cæspitoso-ramosissimis depressis folia rosulata spathulata basi in petiolum attenuata proferentibus; pedunculo simplicissimo scapiformi medio verticillo unico foliorum instructo involucro solitario ebracteato majusculo vel 2–3-capitatis terminato; perigoniis basi cyathiformi breviter angustata extus villosulis, segmentis lato-obovatis; filamentis infra medium plumosis. *E. ovalifolium,* Benth. Eriog., non Nutt. — Blue Mountains of Oregon, Douglas or Gairdner. Not since found: the specimens fructiferous, or nearly so; the color of the fresh flowers unknown. The scarious-persistent perigonia are four lines long, and numerous, forming a globose head two thirds of an inch in diameter. Embryo inflexed, the cotyledons accumbent on the radicle.

12. E. SPHÆROCEPHALUM, Dougl. in Benth. Eriog. Canescenti-tomentosum; caulibus e basi suffruticosa adsurgentibus vel erectis ramosis foliosis; foliis spathulatis angusto-oblongisve basi angustatis verticillatis verticillato-fasciculatis paucisve alternis, pagina superiore nunc glabrescente; pedunculis brevibus nunc subumbellatis vel dichotomis; perigonis flavis, basi stipitiformi pedicello subæquilongo, segmentis oblongo-obovatis vel interioribus spathulatis; filamentis basi villosis. — Variat: 1. Subpedale, foliosum; foliis plerumque angustis margine nunc revolutis, lana laxiuscula; perigoniis extus subvillosis. Oregon and Montana, Douglas, &c. 2. Humilius; perigoniis tenuiter pubescentibus. Simcoe Valley, Washington Territory, Dr. Lyall. 3. Depressum, angustifolium. *E. geniculatum,* Nutt. Pl. Gamb. W. slope

of Rocky Mountains, Nuttall. 4. Latifolium, nanum, umbella sæpius triradiata, radiis brevibus. *E. ellipticum β. megacephalum,* Nutt. l. c. Rocky Mountains, Nuttall. 5. Brevifolium, tomento tenui appressissimo incanum; caulibus simplicioribus multo minus foliatis; perigoniis extus tenuiter pubescentibus. California, Rev. Mr. Fitch, in herb. Torr. Nevada, Stretch, S. Watson.

* * Perigonium extus glaberrimum, basi stipitiformi conspicua.

+- Tota planta glaberrima præter filamenta basi villosa: ovarium etiam glaberrimum. Flores majores in involucro 7 – 8-fido permulti.

13. E. TORREYANUM, Gray, Mss. Spithamæum ad subpedalem; foliis obovato-spathulatis crassiusculis fere aveniis plerisque in caudice confertis; caulibus floridis pedunculisve subvalidis inferne nudis vel medio unifoliatis apice umbellam subsimplicem 3 – 4-radiatam verticillo foliorum subtensam gerentibus; floribus aureis pro genere magnis (lin. 4 – 4½ longis), basi stipitiformi brevi; embryonis rectiusculi cotyledonibus orbiculatis radiculæ subæquilongis. — California, on a high mountain of the Sierra Nevada near Donner's Pass, Torrey, no. 443. Rays of the umbel from one to nearly two inches in length, subtended by a whorl of leaves like the lower leaves but smaller, and sometimes accompanied by one or two solitary and naked short-pedicelled flowers! The lateral rays bear an involucriform whorl of smaller bracts towards their summit, from which sometimes proceeds a short secondary ray. The very numerous flowers form a globular head which in fruit is nearly an inch in diameter: the perigonium scarious-persistent, its segments spatulate-obovate, equal, at the base with a strong costa running down to the stipitiform portion, which is only half a line long.

+- +- Herbæ lanatæ, tomentosæ vel araneosæ, saltem juniores et pagina infera foliorum, nunc demum glabratæ: filamenta inferne villosa: ovarium versus apicem præsertim ad angulos pl. m. hirsutulum. Flores mediocres, in involucro (sæpius profunde 5 – 9-fido lobis patentibus mox reflexis) numerosi, basi stipitiformi in pleris elongata. (Species limitatione difficiles.)

++ Caules floridi adsurgentes plus minus foliati et ramosi.

14. E. POLYANTHUM, Benth. in DC. p. 12. Ultrapedale, laxe ramosum; foliis plerisque verticillatis vel inferioribus verticillato-fasciculatis ovatis oblongisve nunc sublanceolatis acutis subtus præsertim albolanatis; pedunculis aut solitariis vagis aut 2 – 5 umbellatis; basi

stipitiformi floris aurei segmentis dimidio breviore; embryone recto, cotyledonibus oblongo-ovalibus radicula parum brevioribus. — California, from various collections, on the Sacramento, &c.

Var. BAHIÆFORME. Ramosissimum, subpedale; foliis parvulis (semi-pollicaribus) sæpius utrinque dense incanis; floribus minoribus in involucro minus numerosis. — Dry slopes of San Carlos, New Idria, Brewer. Owens Valley, Dr. Horn. This seems to pass on one hand into *E. umbellatum*, on the other into *E. heracleoides*.

++ ++ Caules floridi seu pedunculi scapiformes, e caudicibus cæspitosis laxioribus humifusis vel decumbentibus orti, simplici, aphylli seu verticillo unico rarius duo foliorum instructi, umbella perfecta simplici vel composita rariusve ad involucrum solitarium reducta terminati. Sp. priores majores.

15. E. COMPOSITUM, Dougl. in Benth. Eriog. t. 17, f. 10. Sæpius validum; foliis omnibus e caudice crasso oblongo-ovatis cordatisque longe petiolatis subtus dense cano-tomentosis; scapo nudo fistuloso (sub-sesquipedali) umbellam compositam pleniradiatam verticillo bractearum linearium vel latiorum stipatam gerente; involucro sub-5-fido; perigonii ut videtur albidi segmentis stipite 2 – 3-plo longioribus, exterioribus post anthesin crispulis. — Washington Territory to the northern part of California (Bolander). Bentham has not described and we have not seen the embryo, but from the figure it seems to resemble that of *E. heracleoides*. The var. *leianthum*, Benth., is a state with glabrous or glabrate involucres, and passes into the ordinary form.

16. E. HERACLEOIDES, Nutt. in Jour. Acad. Philad. 7, p. 49. Gracilius; ramis sterilibus decumbentibus subcæspitosis apice fasciculato-foliatis, floridis pedunculisve nunc nudis sæpissime medio verticillo foliorum instructis umbellam simplicem vel compositam plerumque involucrato-bracteatam gerentibus; foliis spathulato-oblongis vel oblanceolatis subtus vel utrinque albo-lanatis; involucro 6 – 8-fido; perigonii pallide lutei segmentis stipite gracillimo vix longioribus; embryonis cotyledonibus orbiculatis radiculæ incurvæ æquilongis. — Rocky Mountains through the interior of Oregon, Nevada, &c. The typical form is from 1½ to 2 feet high, with leaves becoming glabrate above, and a full, many-rayed compound umbel. *E. gyrophyllum*, Nutt. Pl. Gamb. p. 163, is a dwarf form. Var. *minus*, Benth. in DC., is similar or rather smaller, sometimes with leaves only subtending the umbel, and passing into

Var. ANGUSTIFOLIUM, (*E. angustifolium*, Nutt. Pl. Gamb. l. c. *E. umbellatum*, Benth. Eriog. p. 410, t. 18, non Torr.): foliis sublineari-

bus; umbella in macrioribus simplici, in vegetioribus (W. Kootenay, &c. Lyall) iterum iterumque divisa. — Flowers smaller than in *E. umbellatum* and pale, with a proportionally longer stipitiform base.

17. E. UMBELLATUM, Torr. in Ann. Lyc. 2, p. 241, & in Sitgreaves, Rep. t. 12 (mala quoad fl. et embryo). Spithamæum ad pedalem; ramis sterilibus decumbentibus vel repentibus sæpe stoloniformibus laxe cæspitosis apice fasciculato-foliosis; foliis obovato-spathulatis ovalibusque in petiolum angustatis subtus albo-lanatis; pedunculis scapiformibus præter bracteas foliave umbellam simplicem raro subcompositam involucrantia aphyllis; involucro profunde 6–8-fido; perigonii flavi nunc albi segmentis stipite gracili 2–3-plo longioribus; embryonis cotyledonibus fere orbiculatis radicula vix incurva parum brevioribus. — Plains of Nebraska to Oregon, Nevada, and the borders of California. *E. stellatum*, Benth. Eriog. (probably included a small form of the preceding), Hook. Fl. Bor.-Am. t. 177, a northwestern form, represented with the scapes all unifoliate; but this leaf is extremely exceptional, and the whorl of leaves at the middle mentioned by Bentham in DC. Prodr. we have not met with. Var. *majus*, Benth. in DC., is merely a large state. *E. ellipticum*, Nutt. Pl. Gamb., is the same, with the umbel compound, which is uncommon. And there are three or four other unpublished Nuttallian names for the species. Green and glabrate or almost glabrous forms have been collected by Prof. Brewer, S. Watson, and others. The most reduced and diminutive form is

Var. MONOCEPHALUM (*E. Tolmieanum*, Hook. Fl. Bor.-Am. 2, p. 134): pusillum, cæspitoso-depressum; foliis supra vel utrinque glabratis, lamina $\frac{1}{4}$–$\frac{1}{2}$-pollicari; scapo $\frac{1}{2}$–3-pollicari gracili apice involucra 2–4 capitata sæpius 1–3-bracteata vel unicum plerumque nudum majus gerente; floribus pl. m. minoribus. — Oregon on the Walla-Walla among Wormwood, Tolmie. Humboldt and Clover Mountains, Nevada, alt. 9–10,500 feet, S. Watson. Sonora Pass, California, 10,000 feet, Brewer. Uintah Mountains, Utah, 9–10,000 feet, S. Watson. Some forms have green and almost wholly glabrous leaves.

+ + + Herbæ lana tenui densa incanæ; scapi, e caudicibus ramisve sterilibus cæspitosis ut in præcedentibus orti, prorsus aphylli, gracillimi, umbellam simplicem parvi-involucranti-bracteatam gerentes, involucro centrali semper sessili! Flores minores et pauciores in involucro 5–7-dentato, basi breviter stipitiformi, subdioici, umbella mascula contracta capitata. Filamenta basi et ovarium apice sæpius pubescentia.

18. E. MARIFOLIUM, n. sp. Modo *E. umbellati* ramis sterilibus depressis gracilibus substoloniformibus laxe cæspitosis; foliis parvis ovatis utrinque albo-tomentosis vel supra mox glabratis basi rotundatis aut abrupte in petiolum laminam (3 – 5 lin. longam) sæpius excedentem angustatis; umbella 3 – 6-radiata nunc capituliformi in scapo nudo; involucris parvis; floribus luteis (interdum roseo tinctis); semine lanceolato; embryone recto axili, cotyledonibus obovato-oblongis radicula longioribus! — California, Lobb. no. 192 in herb. Hook. Mount Shasta, 7 – 9,000 feet, Brewer: involucres apparently with only male flowers, more or less capitate on a scape only an inch or two long. High mountain near Donner's Pass, Sierra Nevada, Torrey: apparently male flowers in contracted umbels on scapes from two to five inches high; and fruiting plants with scapes eight or ten inches high, bearing an umbel of five or six long rays besides the sessile central involucre. The involucres are only a line or a line and a half long; the perigonia of about the same length, or those with mature fruit accrescent, especially the inner ones, and as much as two and a half lines long.

19. E. INCANUM, n. sp. Densius cæspitosum; caudicibus crassioribus; foliis creberrimis oblongis spathulatisve utrinque cano-tomentosis in petiolum lamina (semipollicari) haud longiorem angustatis; scapo nudo; umbella præter involucrum centrale sessile 5 – 7-radiata nunc capituliformi rariusve ad involucrum solitarium reducta; floribus flavis; semine ovato acuminato; embryone rectiusculo, cotyledonibus ovali-rotundis parum excentricis radiculæ æquilongis. — California, in the Sierra Nevada, Brewer (on the Tuolumne River, alt. 8 – 11,000 feet), Torrey, Bolander. Much more densely cæspitose than the foregoing; the scapes from two to six inches high and less slender; the flowers similar but bright yellow, about a line long, but the accrescent fructiferous perigonium in Bolander's fine specimens from two and a half to three lines long. Involucre with five to seven short and broad erect teeth.

§ 4. PSEUDO-UMBELLATA. Flos basi abrupte constricta brevissima cum pedicello articulatus. Involucra umbellata, rarissime solitaria, multiflora: umbella bracteis foliaceis involucrantibus subtensa, scapum nudum (interdum unifoliatum) terminans. Perigonium 6-partitum, albidum seu luteolum, nec flavum; segmentis obovatis fere conformibus. Ovarium totum vel basi glabrum. Embryo uti notus præcedentium. — Herbæ perennes, cæspitosæ, humiles, floribus ut videtur luteolis seu albidis extus aut laxe pilosis aut glabris.

* Ovarium supra medium laxe villosum.

20. E. PYROLÆFOLIUM, Hook. in Murray, Bot. Exped. Oregon, & Kew Jour. Bot. 5, p. 395, t. 10. Glabratum; foliis in caudice longe fusiformi confertis obovatis seu lato-spathulatis petiolatis coriaceis; bracteis binis umbellam parvam e radiis 3 – 5 brevissimis stipantibus; involucro campanulato villoso; perigoniis albidis? extus basim versus parce villosis; filamentis basi tantum hirsutulis. — Mount Shasta, California, Mr. Jeffrey (herb. Hook.). Scapes a span high, bearing traces of loose villous hairs, which are more decided on the petioles. These lead us to infer, the flowers being essentially alike, that the following is a downy form of the same species.

Var. CORYPHÆUM: nanum, scapo petiolisque villoso-lanatis; foliis ovatis (semipollicaribus) longe petiolatis albido-tomentosis, pagina superiori demum glabrata, involucris in umbella 1 – 3. — Summit of the Cascade Mountains, about lat. 49° on the east side, at the height of 7,500 feet, Lyall. Flowers fully two lines long, apparently white or flesh-colored.

* * Ovarium glaberrimum.

21. E. ANDROSACEUM, Benth. in DC. l. c. Pumilum; foliis in caudicibus dense cæspitosis confertis oblanceolatis spathulatisve in petiolum attenuatis supra glabratis subtus albo-lanatis; scapo 2 – 3-pollicari rarius unifoliato; umbella 4 – 7-radiata simplici nunc subcapitata bracteis verticillatis linearibus stipata; involucris oblongo-campanulatis 5-dentatis; perigonio extus basi pubescente; filamentis fere glabris; embryonis radicula in cotyledonibus brevioribus orbiculatis valde excentricis accumbenti-inflexa. *E. cæspitosum*, Benth. Eriog.; Hook. Fl. Bor.-Am., non Nutt. — Alpine region of the northern Rocky Mountains, Drummond, Bourgeau. Perigonium two, or in fruit nearly three, lines long, the inner segments then more lengthened than the outer.

22. E. LOBBII, n. sp. Humile, primum tomento arachnoideo permolli (præter flores) incanum; foliis in caudice crasso confertis subrotundis in petiolum sæpius longiorem subito contractis crassiusculis, pagina superiori nunc denudata; scapo spithamæo inferne rarius unifoliato; umbella subcomposita densa bracteis verticillatis foliaceis obovatis seu lanceolatis stipata; involucris campanulatis 5 – 7-fidis; perigonio glaberrimo; filamentis inferne villosis; embryonis radicula in cotyledonibus obovato-rotundis excentricis parum brevioribus subinflexa. — California, Lobb in herb. Hook. no. 190. High mountain near Don-

ner's Pass in the Sierra Nevada, Torrey. Porphyritic hills near Virginia City, Nevada, Mr. Stretch in herb. Torr. Leaves 1 to nearly 2 inches in diameter; scape commonly stout. Involucre about half an inch, and the flowers at length three lines long. — Upon Silver Mountain in the Sierra Nevada, at the height of 11,000 feet, Prof. Brewer collected a smaller form, viz.: —

Var. MINUS: foliis tenuioribus involucrisque dimidio minoribus; umbella parvula condensata.

§ 5. LACHNOGYNA. Flos basi ipsa lata cum pedicello articulatus: perigonium extus lanatum, 6-partitum, segmentis oblongis æqualibus. Ovarium lana longa implexa tomentissimum! Filamenta basi tantum pilosa. Involucra pauca in capitulum aut in capitulis paucis subcymosis congesta, nunc solitaria, brevia, 3 – 5-dentata. Embryo (in *E. lachnogyno*) sect. præcedentis. — Herbæ perennes cæspitosæ, incanæ, foliis in caudice multicipiti confertissimis angustis, scapo nudo vel fere nullo, floribus parvis flavis.

23. E. ACAULE, Nutt. Pl. Gamb. Pulvinato-cæspitosum, albo-tomentosum; foliis oblongis vel sublinearibus margine revolutis sessilibus; capitulo ex involucris 1 – 5 fere sessilibus intra folia suprema sessili nunc fructifero breviter exserte pedunculato; perigoniis extus tomentulosis. — Summit of the Rocky Mountains, between Colorado and Utah, Nuttall. Dry sandy ridge near head of Holmes's Creek, Utah? at 6,000 feet, S. Watson in C. King's Expedition. Leaves barely two or three lines long, spreading from the sheathing bases which are imbricated on the branches of the caudex. Flower hardly two lines long.

24. E. LACHNOGYNUM, Torr. in DC. & Bot. Whipp. p. 76, t. 19. Caudicibus brevissimis in radice fusiformi confertissimis; foliis lanceolatis seu lanceolato-oblongis acutis petiolatis margine pl. m. revolutis supra sericeis subtus cano-tomentosis; scapo elongato nudo oligocephalo; perigoniis extus sericeo-lanatis intus flavis. — Mountains of the southern part of Colorado and the adjacent parts of New Mexico, Fendler, Gordon, Bigelow, Newberry. Leaves an inch long besides the slender petiole. Scape slender, a span to near a foot high, more or less cymosely branched at the summit, or in depauperate specimens simple, the branches bearing a loose capitulum of a few involucres, or a solitary involucre sessile in the fork. Flowers a line and a half long, some of them subtended by an ovate or lanceolate firm bract as well as a pair of filiform bractlets, as described and figured by Dr. Torrey. In the letter-

press it is stated that the bract is not represented in the figure, but it is. Bentham describes the embryo as straight, on the authority of a sketch by Dr. Torrey; who, however, from later specimens collected by Dr. Bigelow, has upon his plate well represented the embryo (as strongly excentric), but makes no reference to it in the letter-press.— This and the preceding species are brought together from their resemblance in structure and in the very woolly ovary, rather than in habit.

§ 6. HETEROSEPALA. (Gen. *Eucycla*, Nutt.) Flos basi ipsa haud producta cum pedicello articulatus: perigonium glaberrimum, 6-partitum, omnino petaloideum, post anthesin tenuiter scarioso-marcescens; segmentis tunc biseriatis maxime disparibus, exterioribus rotundatis magis demum auctis basi cordulatis, auriculis usque ad vel ultra articulum extensis; interioribus angustis spathulatis emarginatis mox paullo longioribus conniventi-erectis involutisque, singulis basi unguiformi stamina 3 gerentibus. Involucra (5–8-dentata) capitata vel umbellato-cymosa in scapo prorsus aphyllo simplici. Ovarium glabrum. Embryo incurvus, radicula adscendente cotyledonibus orbiculatis accumbentibus longe superante.—Herbæ perennes, cæspitoso-acaulescentes, canolanatæ, foliis ovalibus vel subrotundis petiolatis in ramis brevissimis caudicis multicipitis confertis, bracteis minimis seu evanidis.

25. E. PROLIFERUM, n. sp. Scapo (spithamæo ad pedalem) umbellam prolifero-compositam gerentibus, radiis primariis 2–6, sequentibus binis nunc solitariis, cum involucro alari semper sessili; perigonii rosei segmentis exterioribus orbiculari-obovatis ovalibusque post anthesin vix aut leviter cordulatis.—Idaho Mountains (Prof. O. Marcy, Prof. Swallow) to N. Fork of the Columbia, Wilkes's Expedition (the plant had been doubtfully referred to *E. oblongifolium*), Weenass Valley and Walla-Walla, Lyall. Foliage nearly as in the next; but the inflorescence cymose-umbellate, usually lax; a central sessile involucre in the primary umbel and in the successive forks, not rarely secund by the suppression of one of the pair of secondary and tertiary rays. Involucres and perigonia after flowering hardly exceeding a line and a half in length. Filaments, as in the next, villous-pubescent below.

26. E. OVALIFOLIUM, Nutt. in Jour. Acad. Philad. 7, p. 50, t. 8. Scapo (3–9-pollicari) capitulo simplici (rarissime prolifero dicephalo) ex involucris paucis (3–8) arcte sessilibus terminato; perigonio aut flavo aut roseo-purpureo, fructifero albido, segmentis exterioribus latis-

sime ovalibus basi sæpius sinu profundiori cordata. *Eucycla ovalifolia* & *E. purpurea*, Nutt. Pl. Gamb. p. 166. — Rocky Mountains of Colorado through Utah to Nevada and the borders of California. Varies with yellow flowers (*E. ovalifolium*, Nutt.) not rarely tinged with purple, to rose or rose-purple (*E. purpureum*, Benth. in DC., &c.); and slender forms with smaller flowers are var. *tennius*, Benth. l. c. (*E. elongatum*, Nutt. herb., changed to *tenellum*, and by Gambell to *E. Nuttallii*, Pl. Gamb. l. c.*) A specimen from Clamet River, of Wilkes's Expedition, has two heads. The flowers and the plant vary considerably in size.

§ 7. CAPITATA. Flos basi lata vel brevissime angustata (haud producta) ipsa cum pedicello articulatus: segmenta perigonii (glabræ raro lanulosi) consimilia subæqualia. Involucra (pauca vel plura) in capitulum globosum sæpius nudum sessilia: capitula solitaria vel pauca subumbellata scapum aphyllum vel pedunculum scapiformem superantia. Ovarium glabrum. Embryo ubi notus fere sect. præcedentis. Herbæ perennes, pl. m. albo-lanatæ.

* Cæspitoso-acaulescentes, pumilæ, monocephalæ; floribus in involucris paucis 5–7-dentatis vix numerosis. Bracteolæ parum barbellatæ.

27. E. KINGII, n. sp. Laxe albo-lanatum; foliis in caudice multicipiti confertis spathulatis obovatis nunc rotundatis (petiolo aut longo aut brevi); scapo tenui; involucris in capitulo 6–9 turbinato-campanulatis profundius 6–7-dentatis tenui-membranaceis; perigonio glaberrimo luteo vel roseo-purpureo, segmentis obovato-subcuneatis omnibus emarginatis; filamentis fere glabris. — Summit of E. Humboldt Mountains, Star Peak, and Clover Mountain, Nevada, alt. 9–11,000 feet, Sereno Watson in Clarence King's Expedition, July–August, 1868. Leaves exclusive of the petiole about half an inch long. Flowers a line and a half in length. Embryo with a slender radicle, its base ascending and accumbent on the orbicular cotyledons.

Var. LAXIFOLIUM. Elatius; caudice ramis gracilioribus; foliis parcioribus sublanceolatis; floribus in sicco aureis. — Parley's Park

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* Nuttall describes *E. Nuttallii* as having the "segments of the perianth oblong and not very unequal"; but in those of his own specimens which have any flowers, as in his "*E. polyceps*," Mss., which he evidently put with it, the perigonium is just that of *E. purpureum*. So that he should not have left it in *Eriogonum* when he formed of the above his genus *Eucycla*. It might be supposed that Nuttall had our next species (*E. Kingii*) in view, but there is no trace of it in his own herbarium, nor among the specimens he contributed to the herbaria of Hooker, Durand, &c.

Peak, alt. 9000 feet, Wasatch Mountains, Utah, S. Watson. Leaves *acute, sometimes an inch long, tapering into a slender petiole.* Scape nearly a span high.

28. E. MULTICEPS, Nees, Verz. Pl. Max. v. Wied (extr. Trav. Neu-Wied), p. 20, ex char. Lana appressa candidissima indutum, caudicis ramis breviter adsurgentibus foliosis; foliis oblongo-spathulatis oblanceolatisve in petiolum longe attenuatis; scapo 3–5-pollicari; capitulo bracteato; involucris 5–10 tubulosis 5-dentatis; perigonio albo vel fusco-flavido extus sublanuloso, segmentis obovato-cuneatis retusis; filamentis glabriusculis. *E. gnaphalodes*, Benth. in Kew Jour. Bot. 5, p. 263 (1853). — Colorado, cliffs of the Upper Platte, Neu-Wied, Geyer, Gordon, Hayden, H. Engelmann, E. W. Emerson. Bracts under the head more conspicuous and involucrate than in other species of the group, one or two of them equalling or surpassing the involucres. Flowers small. *E. multiceps*, Nees, much anterior to Bentham's name, has been wholly overlooked, which, from the place of publication, is not surprising.

29. E. PAUCIFLORUM, Pursh, Fl. 2, p. 735. Glabrescens, *Armeriæ* facie; caudicis ramis brevissimis crebris; foliis linearibus subspathulatisve margine revolutis in petiolum longe attenuatis supra mox glabratis; scapo subspithamæo; involucris in capitulo 5–10 turbinato-campanulatis 5-dentatis; perigonio albo glabro, segmentis ovalibus; filamentis inferne pubescentibus. — Nebraska to the Rocky Mountains in Colorado, Bradbury, H. Engelmann, Parry.

* * Majores, subacaules, caulibus basi nunc breviter adsurgente tantum foliatis; pedunculo valido scapiformi nudo capitulo aut solitario aut paucis umbellatis sat magnis superato; involucris brevi-campanulatis truncatis (dentulis 5–8 membranula prorsus connexis) permultifloris. Bracteolæ villoso-plumosissimæ ex involucro mox exsertæ. Perigonium semper album, glaberrimum, segmentis latis. (*Desmocephalorum* Benth. species.)

30. E. LATIFOLIUM, Smith in Rees Cycl. Sæpius 1–2-pedale; foliis ovalibus basi lata rotundatis cordatisve subtus albo-lanatis supra cum scapo lana araneosa plus minus decidua; involucris in capitulo nunc pollicem lato 5–12 lanatis 5-dentulis; perigonii segmentis lato-obovatis. *E. arachnoideum*, Esch. — Coast of California, from Santa Cruz northward to Humboldt Co. Leaves one to two inches long, on petioles (as in other species) of variable length.

31. E. OBLONGIFOLIUM, Benth. Eriog. & in DC. l. c. Gracilius, spithamæum ad pedalem; foliis oblongis ovalibusque basi sæpius acutis; involucris glabratis 6–8-dentulis; perigonii segmentis oblongo-obovatis. — California, along the coast, with the same range as the preceding, of which it is likely to prove a smaller or depauperate and narrower-leaved variety; the matted tomentum sometimes deciduous even from the lower face of the leaves. Var. β.? *minus*, Benth. in DC., with only five and more prominent teeth to the involucre, is probably different; but the solitary specimen is incomplete and insufficient.

§ 8. CAPITELLATA. (*Desmocephalorum* sp. Benth.) Flos basi haud producta ipsa cum pedicello articulatus: perigonium 6-partitum glabrum vel villosulum, segmentis obovato-oblongis fere æqualibus. Involucra (truncata subdentata) pluriflora, pauca in capitula pl. m. paniculato-cymosa in scapo nudo congesta, nunc tantum gemina, alaria nec-non solitaria. Bracteolæ plumosæ. Ovarium glabrum. Embryo incurvus, cotyledonibus latis brevibus. — Herbæ perennes, foliis omnibus radicalibus latis margine sæpius undulatis, scapis 1–3-pedalibus nudis junciformibus nunc fistulosis cum involucris mox glabratis vel glabris, floribus (an semper?) albis.

32. E. NUDUM, Dougl. in Benth. Eriog. Foliis subtus cano-(quandoque fulvo-) tomentosis ovatis rarius obovatis basi sæpius subcordatis, petiolo plerumque longo gracili; paniculæ dichotomæ ramis elongatis; involucris cylindraceo-campanulatis ore truncato (dentibus 6–8 membranula prorsus connexis), alaribus sessilibus; perigonio extus sæpius glabro intus basi nunc parce piloso. *E. arachnoideum*, Hook. & Arn. Bot. Beech., non Esch. — Oregon and California, chiefly towards the coast. Magnopere variat:

Var. β. (*E. affine*, Benth. in DC.) Sublanatum, nempe scapo involucrisque lana araneosa tarde decidua obductis. — Umqua, Pickering and Brackenridge in Wilkes's Expedition; Jeffries in herb. Kew; apparently a form with foliaceous bracts at the lower nodes of the scape, and the flowers seem to be yellow!

Var. γ. (*pubiflorum*, Benth. l. c.) Involucris interdum fere omnibus in paniculæ ramis solitariis, perigonio extus pilosiore. — California, Fremont, Rich, Heermann, Horn, &c. But there are traces of this pubescence in many, if not most, specimens of *E. nudum.*

Var. δ. (*E. auriculatum*, Benth. Eriog.) Petiolis basi interdum dilatatis seu auriculato-dentatis; scapo nunc inflato; involucris sæpius

angustioribus solitariis. — Commoner southward in California, especially forms with the scape inflated, of which Prof. Brewer collected several, some of them with all the involucres solitary and almost as in the section *Virgata*.

33. E. ELATUM, Dougl. l. c. Foliis mollissime villoso-pubescentibus vel subtus fere velutinis ovato-oblongis sublanceolatisve basi (raro subcordata vel subhastata) in petiolum angustatis; scapo cum panicula rigido; involucris magis turbinatis repando-5-dentatis, alaribus nonnunquam solitariis longius pedicellatis, cæteris nunc potius glomerato-congestis quam capitatis; perigonio basi extus pilosulo. — Washington Territory to California and Nevada, on plains. The pubescence of the flower is variable in degree, but not wanting as described by Bentham. Southward the scape is sometimes inflated.

§ 9. FASCICULATA, Benth. olim. Flos, etc. præcedentium. Ovarium glabrum. Involucra (truncata subdentata, dentibus membranula primum connexis) perpluriflora, in capitula vel cymulas capituliformes congesta, capitulis pl. m. bracteatis pedunculos dichotomos vel cymoso-umbellatos terminantibus, alaribus (aut ramo altero abortiente lateralibus sessilibus. Bracteolæ plumosæ. — Suffrutices foliosi, foliis parvulis alternis et in axillis fasciculatis subtus incanis margine sæpius revolutis; floribus albis nunc roseo tinctis,

* Extus sericeo-villosis haud numerosissimis. Folia minus conferta. Embryo subrectus, radicula gracili in cotyledonibus ovalibus parvulis leviter inflexa.

34. E. CINEREUM, Benth. Bot. Sulph. p. 45, & in DC. l. c. Fruticosum, laxe ramosum, pube tenui canescens; foliis secus ramos subfasciculatis ovatis margine undulatis minus aut vix revolutis subtus incanis breviter petiolatis; pedunculis elongatis junciformibus fere nudis superne dichotomis; capitulis paucis laxiusculis. — California, San Pedro, Hinds or Barclay; Santa Monica, on sands of the sea-shore, "a shrub three to five feet high, forming dense patches," Brewer. Leaves varying from orbicular to obovate, ovate, and almost oblong, from half an inch to an inch in length, mostly with a distinct short petiole. Cotyledons oval, somewhat excentric, barely twice the breadth and little more than half the length of the slightly inflexed radicle.

* * In involucris numerosissimis, demum secus axin elongandum haud raro quasi racemosis, extus glabris vel pilosulis. Suffrutices, ramis creberrime ac fasciculatim foliosis. Folia parva margine

revoluta. Radicula in cotyledonibus orbiculatis dimidio brevioribus accumbenti-incurva.

35. E. PARVIFOLIUM, Smith in Rees Cycl. Primum arenoso-lanatum; foliis ovatis seu ovato-lanceolatis undulatis basi abrupta vel obtusa pl. m. petiolatis subtus tomentosis; ramis floridis seu pedunculis 2–3-chotomis; perigoniis glabris. — California, near the coast; by all collectors, from Hænke and Menzies downwards. Var. *crassifolium*, Benth. Pl. Hartw. no. 1940, is a very condensed form, from the sea-coast at Monterey.

36. E. FASCICULATUM, Benth. Eriog. Aut glabrum aut tomentulosum; foliis oblongo-linearibus seu lineari-spathulatis sæpius maxime revolutis; majoribus pl. m. in petiolum brevem sensim attenuatis; pedunculo nudo gracili sæpissime umbellatim diviso 3–6-radiato. — California from Monterey southward.

Var. α. (*E. rosmarinifolium*, Nutt. Pl. Gamb. p. 164. *E. fasciculatum*, Benth. Eriog. p. 410.) Præter folia subtus maxime revoluta tenuiter albo-tomentosa fere glaberrimum; involucri 5-carinati dentibus 5 triangularibus paullo exsertis; perigoniis glabris.

Var. β. (*E. rosmarinifolium β. foliolosum*, Nutt. l. c. *E. fasciculatum*, Benth. in DC. Prodr. p. p.) Plus minus pilosulo-pubescens; involucro magis truncato (dentibus ultra sinus tenui-membranaceos haud productis) perigoniisque extus leviter pubescentibus.

Var. γ. POLIFOLIUM. (*E. polifolium*, Benth. in DC. l. c.) Pube tenui undique cinereum vel canescens; foliis minus revolutis, pagina superiore nunc glabrescente; pedunculo vulgo longiore; involucro etc. var. β. — From Monterey to San Diego and the Gila. The forms α and γ are seemingly very different, but they run together completely. The teeth, or firm portions at the orifice of the involucre, do not project beyond the scarious-membranaceous sinuses except in the first, and in this sometimes very slightly.

§ 10. CORYMBOSA, Benth. Flos basi haud producta ipsa cum pedicello articulatus; perigonium 6-partitum, extus glabrum, segmentis interioribus sæpissime pl. m. minoribus. Ovarium glabrum vel glabellum. Involucra pluriflora, 5–6-dentata, cymosa, nempe pedunculo nudo apice umbellatim diviso, radiis repitite 2–3-chotome vel umbellatim in cymam corymbiformem subdivisis, ultimis seu pedicellis brevibus aut (præsertim alaribus) nullis. Embryo incurvus, cotyledonibus orbiculatis radiculæ multo longiori pl. m. accumbentibus. Caules inferne sæpius foliosi. Folia plerumque angusta et alterna, etiam radicalia haud cordata, subtus vel utrinque pl. m. albo-lanata.

* Fruticuli, nunc caulibus abbreviatis parum suffruticosis. Perigonia intus glabra, segmentis subsimilibus. Ovarium superne ad angulos sæpe scabridum.

+- Rami lignosi erecti vel adsurgentes, foliosi, pedunculo cymifero aut brevi aut longiusculo terminati. Flores albi vel rosei (raro in eadem speciei lutei); perigonio basi post anthesin sæpius crassiusculo, segmentis obovatis saltem interioribus emarginatis vel retusis.

37. E. ERICÆFOLIUM, n. sp. Depressum, tortuoso-ramosissimum; foliis in ramulis creberrimis subulato-linearibus (lin. 2 longis) supra glabris subtus albo-lanatis sed ob margines maxime revolutos quasi teretibus subtus leviter canaliculatis; cyma in pedunculo vix ultra folia suprema exserta parva ex involucris 3-7 confertis tomentulosis pentagonis breviter 5-dentatis; floribus albis sesquilineam longis. — Arizona, near Fort Whipple, Drs. Coues and Palmer, Sept. 1865. The branches or stems we possess are barely a span long, rigid, and wholly fruticulose. Involucre a line and a half long. Segments of the perigonium all nearly alike, dilated-obovate.

38. E. CORYMBOSUM, Benth. in DC. Sesqui-bipedale, floccoso-lanatum; ramis validis alte foliosis; foliis oblongis subundulatis (8-18 lin. longis); cyma late corymbosa floribunda; floribus ut videtur albis sesquilineam longis. — Utah and W. New Mexico, Fremont, Beckwith, Newberry (San Juan River, in Macomb's Expedition), Whipple. The var. *divaricatum*, Torr. & Gray, Pacif. R. R. 2, p. 129, & 4, p. 131, is not unlike Fremont's, but in better specimens, and much whitened by the more persistent floccose wool. Cyme broader and fuller than in the broadest-leaved forms of the next species, which approach this; but the flowers mostly twice as large, and the stem and branches stouter.

39. E. MICROTHECUM (or *microtheca*), Nutt. Pl. Gamb. p. 162. Humilius, vix ultrapedale, a basi ramosissimum, tomento floccoso nunc tenuiore; foliis angusto-oblongis linearibusque; cyma aut confertiflora aut effusa; floribus albis nunc roseis raro luteis haud ultra lineam longis. — Mountains or high plains, Nebraska to New Mexico, the interior of Northern California, and Oregon. This includes a variety

of forms, several of them described as species; but only the larger forms with broad leaves, and some with much larger involucres (var.? *Fendlerianum*, Benth.) and approaching the preceding species, stand in the way of the present inevitable union. The

Var. α. (*E. microtheca*, Nutt., Benth. in DC.) is a low form with linear or linear-oblong nearly plane leaves and open corymbose cymes on a rather long peduncle; involucres a line to a line and a half long. *E. laxiflorum*, Nutt. (the var. β.? *laxiflorum*, Benth.) is the same, with involucres a trifle larger and fewer in the cyme. Forma *alpina, pygmæa*. A very depauperate, short-stemmed, and comparatively long-peduncled alpine form was gathered by Prof. Brewer in Sonora Pass, Sierra Nevada, alt. 9,000 feet, in loose sand; and somewhat similar ones, only two inches high, on the Humboldt Mountains, Nevada, alt. 10,000 feet, by S. Watson. Geyer's 253, with white flowers, and a broader-leaved form with yellow flowers, collected by S. Watson on the Wasatch Mountains in Utah (both with short and low leafy branches and long peduncles), connect this with the

Var. β. FENDLERIANUM, Benth. Majus, latifolium; involucris lin. 2 longis in cyma ampla laxa. — New Mexico, Fendler, no. 767. Remarkable for the size of the parts, the leaves being an inch or an inch and a half long, including a distinct petiole of four to six lines, flat, and four or five lines wide. Specimens from Nevada (Brewer, Torrey, Bloomer, &c.), some with narrower, others with almost oval leaves, hardly an inch long, connect this with

Var. γ. CONFERTIFLORUM. (*E. confertiflorum*, Benth.) Fruticulosum, foliosum; foliis anguste oblongis; cymis confertifloris sæpius contractis. — Utah to interior of Oregon, and northern part of California. Flowers either white, deep rose-color, or sometimes apparently yellow. Bentham's var. *Stansburyi* has the dense floribund cyme of this, but the longer naked peduncle and narrow revolute leaves of some of the succeeding forms.

Var. δ. LEPTOPHYLLUM. (*E. Simpsoni*, Benth. in DC. excl. β. *E. effusum*, var. *leptophyllum*, Torr. in Sitgreaves Rep. p. 168, excl. tab. 10. *E. effusum*, var. *foliosum* in Pacif. R. R. 2, p. 129.) Foliosum; foliis anguste linearibus margine valde revolutis glabratis; cyma brevi sæpius conferta floribunda. — Utah and New Mexico, Gunnison, Woodhouse, Simpson, Whipple, Newberry. Bentham's *E. Simpsoni*, var. *floccoso-lanata*, is only *E. annuum*. Torrey's plate of *E. effusum*, var. *leptophyllum* (Sitgreaves, t. 10), with long naked peduncle, short caudex-like stem, and strongly toothed involucre (this said in the letter-press to be nearly toothless, and the stems leafy), really belongs to his *E. Fremonti*, i. e. to *E. brevicaule*.

Var. ε. EFFUSUM (*E. effusum*, Nutt. l. c.) Magis lanatum; foliis oblongo-linearibus nunc angustioribus margine demum pl. m. revolutis; cyma floribunda decomposita paniculato-effusa, radiis sæpius longioribus; floribus albis. — Nebraska to Montana and N. New Mexico. Some specimens (such as 192, Dr. Parry, from Huefano Mountains, and Bentham's β. *rosmarinoides*, which is not from California, probably from the Platte) connect this perfectly with the preceding form, and with the proper *E. microthecum*.

Var. ζ. LEPTOCLADON. (*E. leptocladon*, Torr. & Gray in Pacif. R. R. 2, p. 129.) Gracilius; foliis linearibus; cymis laxe paniculatis, involucris nunc (ramulo altero abortiente) unilateralibus. — On Green River, Utah, Gunnison.

The name *E. microthecum*, rather than *effusum*, is adopted for the species, because the latter is imperfectly characterized from a specimen not yet in flower, and the name is far from applicable to all the forms.

+ + Rami foliati lignescentes brevissimi vel cæspitoso-depressi, pedunculum nudum elongatum scapiformem herbaceum proferentes. Flores præcedentium, sed perigonii segmenta inter se fere æqualia. Pedunculi et involucra 5-dentata glabri vel mox glabrati.

40. E. BREVICAULE, Nutt. Pl. Gamb. Cæspitoso-fruticulosum; foliis linearibus oblongo-linearibus vel anguste spathulato-oblanceolatis in petiolum gracilem attenuatis undique niveo-lanatis vel supra glabrescentibus; scapis rigidis 3–10-pollicaribus; cyma repitite umbellatim vel trichotome divisa, ad nodos calyculiformi-bracteatis; perigonii nunc flavi segmentis obovato-oblongis. *E. brevicaule, campanulatum & micranthum*, Nutt. l. c. *E. Fremonti*, Torr. in Frem. Rep. unpublished. *E. effusum* var., Torr. in Sitgreaves Rep. t. 10 (non descr. p. 168). *E. effusum* var.? *nudicaule*, Torr. Bot. Whipp. Pacif. R. R. 4, p. 132. — Rocky Mountains, from the Platte to N. New Mexico, Utah, and adjacent parts of Oregon. Nuttall's three species (one of them omitted by Bentham) are not permanently distinguishable, even as varieties, and some forms of the preceding species are occasionally too close. The leaves vary from 1 to 2½ inches long, exclusive of the petiole, and from one to five lines in breadth, their margins

at length mostly revolute. Cyme ample, sometimes rather fastigiate, sometimes very open; the bracts at each node short and connate into a calyculus, which is white-woolly inside. Involucres either glabrous or the wool early deciduous, varying from oblong to cyathiform-campanulate, and from a line and a quarter to nearly two lines in length; the flowers of about the same length.

41. E. LONCHOPHYLLUM, n. sp. Cæspitosum? elatius; caulibus basi vix lignescente breviter foliatis; foliis lanceolatis seu lato-linearibus in petiolum gracilem attenuatis subtus albo-lanatis; pedunculo elongato in cymam repitite trichotomam paniculæformem soluto; bracteis inferioribus filiformibus, summis subulatis; perigonii albi segmentis obovatis retusis. — On the Rio Blanco, interior of New Mexico? Newberry in Macomb's Expedition: herb. Torr. Leaves not much crowded on the base of the single stem seen, about three inches long, and tapering into a petiole of an inch or more in length, obtuse, rather thin, flat; the somewhat scape-like peduncle with the loose cyme a foot in length, the primary divisions four inches long. Involucres fewer-flowered than in the preceding, the flowers of about the same size.

* * Annua, transmontana, caulibus laxe ramosis inferne tantum foliosis. Perigonia rosea, intus glaberrima, segmentis consimilibus fere æqualibus. Bracteolæ vix barbellatæ.

42. E. TRUNCATUM, n. sp. Laxe floccoso-lanatum, pedale; foliis plerisque ad nodos inferiores subfasciculatis spathulatis oblongisve in petiolem gracilem attenuatis; pedunculis elongatis nudis; cyma laxa 2–3-chotoma ex involucris pauciusculis multifloris oblongo-campanulatis ore truncato, alaribus sessilibus; bracteis minimis; perigonii segmentis obovatis. — California, on the summit of the eastern peak of Monte Diablo, Brewer. Leaves an inch and a half long, including the petiole. Involucre two lines long, thin and scarious between the broad greenish ribs, which are connected to the very top. Perigonium a line long.

* * * Annua, cismontana, caulibus elatis strictis sursum longe foliatis. Perigonia alba, fundo lana longa tenuissima arachnoidea instructo, segmentis disparibus, exterioribus multo majoribus. Bracteolæ tenuiter plumosæ. Cymæ decompositæ floribundæ.

43. E. ANNUUM, Nutt., Benth. in DC. Albo-lanatum; foliis oblongis basi attenuatis plerisque petiolatis; involucris niveo-lanatis intus glabris breviter 5-dentatis; perigonii segmentis exterioribus late obovatis, interioribus oblongis. *E. Lindheimerianum*, Scheele in

Linnæa. *E. Simpsoni* β. *floccoso-lanata*, Benth. l. c. — Plains of Nebraska, Arkansas, and Texas to the Rocky Mountains and New Mexico. — Forma parviflora, involucris brevioribus lana floccosiore, caule cymis nonnullis axillaribus proferente. *E. cymosum*, Benth. l. c. — Western Texas, Wright. N. Chihuahua, Thurber.

44. E. MULTIFLORUM, Benth. Eriog. Lana floccosa albidum; foliis oblongis lanceolatisque undulatis, caulinis sessilibus basi obtusa vel auriculata; involucris perplurimis 5-lobatis extus sæpe denudatis intus arachnoideo-lanatis; perigonii segmentis eximie biseriatis, exterioribus orbiculato-ovalibus demum sinu profundo cordatis, interioribus fere linearibus. — Plains of Arkansas, Louisiana, and Texas.

§ 11. VIRGATA, Benth. Flos basi haud producta ipsa cum pedicello articulatus; perigonium 6-partitum fere semper glabrum. Ovarium glabrum vel ad angulos hispidulum. Involucra (sæpius parva vel angusta) sessilia, secus ramos paniculæ plerumque virgatos unilateraliter disposita. Embryo incurvus, cotyledonibus brevibus radiculæ gracili pl. m. incumbentibus.

* Perennia, in paucis basi suffruticosum, incano nunc floccoso-lanatum. Flores albi, nunc roseo tincti, glaberrimi, in involucro plures.

+ Perigonium basi lata quasi truncatum, ob segmenta 3 exteriora accrescentia lato-ovalia marginibus a basi ipsa discretis atque subauriculato-rotundatis. Panicula sæpe dichotoma. Bracteæ plerumque subfoliosi.

45. E. NIVEUM, Dougl. in Benth. Eriog. Tomento denso (in caulibus floccoso) candido-lanatum, ultrapedale, basi suffruticosum; caulibus floridis inferne foliatis vel subnudis; foliis ovatis oblongisve longius petiolatis; involucri dense lanati dentibus 3 – 4 subulatis cum bracteis pl. m. recurvo-patentibus, cæteris minutis vel nullis; perigonii segmentis exterioribus mox accrescentibus orbiculato-ovalibus (basi fere cordulatis) interiora obovato-spathulata inferne angustata includentibus. — Interior of Oregon and Washington Territory, Douglas, Geyer, Spalding, Cooper, Lyall.

Var. DECUMBENS (*E. decumbens*, Benth. l. c.): forma ramosiore, ramis nunc decumbentibus magis foliatis, floribus paullo majoribus. — Interior of Oregon, Douglas. No other specimens are so well marked as those of Douglas, but Spalding's plant approaches them. Bracts in the species mostly equalling or exceeding the involucre, the three more

or less spreading or recurved teeth of which (sometimes as long as the tube itself, but variable) are peculiar.

46. E. DICHOTOMUM, Dougl. l. c. Præcedenti subsimilis; ramis e caudice cæspitoso-multicipiti brevibus crebre foliatis; foliis oblongis in petiolum attenuatis; pedunculis strictis scapiformibus rarius foliatis (subpedalibus); bracteis appressis involucro breviuscule obtuseque subæqualiter 3–5-dentato brevioribus; perigonii segmentis exterioribus obovato-ovalibus. — Forma humilis, *E. album*, Nutt. Pl. Gamb. Forma paniculis magis virgatis, *E. strictum*, var. *lachnostegia*, Benth. in DC. Interior of Oregon, and Utah, Douglas, Nuttall, Fremont.

+ + Perigonium basi acutum, segmentis conformibus.

++ Scaposa, stricta.

47. E. STRICTUM, Benth. Eriog. excl. β. Basi cæspitoso-ramosissimum; foliis confertis spathulatis seu obovato-oblongis in petiolum longe angustatis subtus albo-lanatis; scapis gracillimis (pedalibus) glabris vel mox glabratis di–trichotome ramosis; bracteis parvis subulatis adpressis; involucris (lineam longis) glabratis campanulatis equaliter 5-dentatis; perigonii segmentis ovalibus oblongisve; ovario glaberrimo. — Blue Mountains of Oregon, Douglas only. We find no specimen from Fremont, except of the var. *lachnostegia*, which clearly belongs to the foregoing species. This has similar dichotomous inflorescence, but much more slender, and involucres and flowers only half as large.

48. E. RACEMOSUM, Nutt. Pl. Gamb. Floccoso-lanatum; foliis e caudice subterraneo longe petiolatis ovatis oblongisve nunc subcordatis subtus albo-lanatis; scapo valido (1–2-pedali) nudo rariusve ad nodos inferiores folioso-bracteatis; involucris tubuloso-campanulatis obtuse 5-dentatis floribundis secus ramos subsimplices paucos rigidos stricte spicatis appressis; perigonii majusculi (lin. 2 longi) rosei seu albi segmentis obovatis; ovario glaberrimo vel superne scabrido. *E. orthocladon*, Torr. in Sitgreaves Rep. p. 167, t. 8, & DC. l. c. *E. obtusum*, Benth. in DC. l. c., forma foliis subrotundis. — N. New Mexico and Utah, Fendler, Fremont, Gambell, Remy, Simpson, Woodhouse, Bigelow, Newberry, Watson. Leaves 1–2½ inches long, the petioles mostly still longer. Scape rigid, usually only once or twice forked, sometimes more paniculate; the branches erect and strict, when few elongated; the numerous involucres approximate and, with their numerous flowers, forming a virgate spike rather than a raceme. Cotyledons orbicular, very excentric, rather shorter than the incurved radicle.

++ ++ Caulescentia, diffuso-paniculata.

49. E. Wrightii, Torr. in DC. l. c. E basi suffruticosa ramosum, 1 – 2-pedale; ramis inferne foliosis; foliis oblongo-ovatis vel sublanceolatis basi angustatis utrinque vel subtus albo-lanatis (6 – 12 lin. longis), minoribus sæpe in axillis fasciculatis; panicula dichotome ramosa; involucris parvi-bracteatis secus ramos rigidulos laxius spicatis 5 – 6-dentatis (lin. 1 – 1½ longis); perigonii (lin. 1 – 1½ longi) segmentis lato-obovatis vel exterioribus suborbiculatis; ovario superne præsertim ad angulos hirtello-scabro. *E. Wrightii* (Torr.), *trachygonum* (Torr.) & *helianthemifolium*, Benth. in DC. l. c. — S. W. Texas to Arizona, Nevada, and California, Wright, Parry, Thurber, Newberry, Palmer, Torrey, Brewer, &c. But Scheer's plant from Chihuahua appears to be *E. polycladon*, Benth. A polymorphous species. The *E. trachygonum* has larger and more numerous flowers; var. *floccosum*, Benth. shorter involucres; and a depauperate form from Nevada (Anderson, Bloomer, Torrey, Brewer) very short leafy branches and more scape-like peduncles.

* Annua, vel in spec. prima forte perennantia. Flores parvi, albi vel rosei, basi acuti vel acutiusculi. Bracteæ parvæ, adpressæ.

+ Involucra tubulosa, lin. 3¼ – 2 longa, in depauperatis *E. viminei* vix minora, adpressa.

++ Pluriflora, canescenti-lanata, secus ramos plerumque subsimplices dissita. Perigonium glabrum (lin. 1 – 1½ longum), segmentis obovatis fere æqualibus. Plantæ juniores omnino albo-lanatæ, tomento caulium, etc. demum floccoso rarius deciduo.

50. E. elongatum, Benth. Bot. Sulph. & in DC. l. c. Caulibus ramisve virgatis e basi indurascente (vix perenni?) sesqui–tripedalibus nudis basim versus foliis oblongo-lanceolatis petiolatis parce nunc parcissime instructis; involucris 3 – 3¼ lin. longis sat multifloris secus ramos simplices strictos spicatis remotis, ore repando-truncato; bracteolis sursum parce villoso-barbatis; perigonio albo vel subroseo; ovario glabro. — California, plains and hills, from Monterey to San Diego, &c. Dr. Torrey, in Bot. Mex. Bound. and Ives Exped., refers this to *E. virgatum*, to which indeed it is related, and the root probably is not really perennial. Besides the greater size and stoutness, and the more numerous flowers in the involucre, the achenium is more tapering, the embryo of twice the size, a line or more in length, and the radicle springs from near the uppermost part of the oval-orbicular cotyledons.

51. E. VIRGATUM, Benth. in DC. Caule gracili 1½ – 2 pedali aut basi tantum aut superne parcius foliis ovatis oblongisve instructis, ramis paucis plerumque simplicibus longe virgatis nunc paniculato-ramosis; involucris dissitis 2 – 2½ lin. longis, ore 5-dentato; bracteolis vix barbellatis; perigonio albo; ovario et achenio abrupte rostrato superne saltem ad angulos hirtello-scabris. — California, on the plains, usually more northern than the preceding, Fremont, Bridges, Wallace, Brewer, Bolander, &c. Embryo half a line long, with short orbicular accumbent cotyledons. A luxuriant form collected by Bolander, two or three feet high, with the numerous virgate branches here and there leaf-bearing, passes into

Var. ROSEUM (*E. roseum*, Durand & Hilgard, in Jour. Acad. Philad. 3, p. 45 (1854) & Pacif. R. R. 5, p. 14, t. 15): caule ramoso ad paniculam usque laxam foliato; involucris in ramulis brevibus paucis; perigonio roseo. — Posé Creek, California, Dr. Heermann: earlier published than *E. virgatum*. To this belongs *E. verticillatum*, Nutt. Pl. Gamb. l. c., the earliest name, but most imperfectly characterized from a specimen not yet in flower.

++ ++ Involucra pauciflora vel subpluriflora, anguste tubulosa (haud ultra lineas 2 longa), secus ramulos tenues paniculæ diffusæ amplæ dissita, perigoniis (glabris aut pilosis) etiam fructiferis longiora. Bracteolæ vix barbellatæ. Plantæ demissæ (spithameæ ad pedalem), superne tenuiter tomentosæ vel glabræ.

52. E. DASYANTHEMUM, n. sp. Lana tenui flocculosa cinereum vel superne glabratum, inferne foliatum; foliis subtus incano-lanatis rotundatis in petiolum abrupte angustatis; involucris pauci–plurifloris breviter 5-dentatis; perigonio extus saltem basi tenuiter villoso, segmentis obovatis fere æqualibus. (*E. vimineum*, var. *eriocladon* Benth. in DC.? Spec. in herb. Benth. & herb. Torr. haud reperta.) — California: near Clear Lake, Bolander, Torrey; also Borax Lake, Torrey, a more glabrate form, both as to the panicle and involucre, and the exterior of the flower, the pubescence of which in other specimens is very conspicuous. Branches of the diffuse panicle less slender and compound, and the flowers rather larger, than in *E. vimineum*; the involucre commonly hoary, and fully two lines long, sometimes 15 – 20-flowered.

53. E. VIMINEUM, Dougl. in Benth. Eriog. Foliis radicalibus rotundatis subtus incani- supra araneoso-lanatis; involucris sparsis pauci-

floris brevissime 5-dentatis cum ramis tenuissimis paniculæ effuso-decompositæ glabris; perigonio glaberrimo, segmentis exterioribus late obovatis, interioribus angustioribus.— Washington Territory to California and Nevada; apparently very common. Involucre slender, about a line and a half or sometimes two lines long.

++ ++ ++ Involucra pauci- vel subpluriflora, oblongo-campanulata, subturbinata, 5-dentata, circa lineam longa, secus ramulos tenues paniculæ plerumque ramosissimæ dissita vel sparsa. Perigonium glabrum, post anthesin involucro brevius, segmentis interioribus angustioribus. Folia subtus albo- supra sæpiusque cum ramis et involucris floccoso-lanata, nunc omnia radicalia, nunc plus minus caulina.

54. E. GRACILE, Benth. Bot. Sulph. & in DC. l. c. Sæpius ramosissimum, paniculæ ramis patentibus; foliis ovatis, oblongisve; bracteolis in involucro brevibus tenuiter subglanduloso-barbellatis; perigonii (albi vel rosei) segmentis exterioribus obovatis, interioribusve oblongis. — California and Nevada, apparently common and widely variable; some of the glabrate forms approaching *E. vimineum*, which has similar only minutely barbellate bractlets at the base of the pedicels. Bentham's original plant has leaves on the lower nodes.

Var. β. EFFUSUM: humile; panicula decomposita patentissima involucrisque sæpius glabratis; foliis omnibus radicalibus. — Chiefly southward, and in Nevada; the involucres and flowers sometimes rather large for the species, sometimes very small.

Var. γ. LEUCOCLADON (*E. leucocladon*, Benth. Pl. Hartw. p. 333, & in DC. l. c.): albo-lanatum; caule nudo subsimplici; ramis paniculæ paucioribus strictiusculis; floribus albis.

Var. δ. ACETOSELLOIDES (*E. acetoselloides*, Torr. in DC. l. c.): albo-lanatum; caule longe usque ad paniculam subsimplicem foliato; floribus rubentibus. — California, Fitch, Shelton, only in herb. Torr.; and Remy collected a form connecting with the preceding.

55. E. POLYCLADON, Benth. in DC. Lana persistente dealbatum; caule 2–3-pedali usque ad paniculam amplam strictiusculam foliato; foliis oblongis obovatisque; bracteolis in involucro pilis tenuissimis longissimis parciusculis villosis; perigonii albi segmentis exterioribus flabellato-cuneatis, interioribus obovato-spathulatis, utrisque basi attenuatis. — S. W. Texas, Wright, to Chihuahua, Potts (*E. helianthemifolium*, Benth. in DC. Prodr., quoad pl. " herb. Scheer,") and Ari-

zona, Thurber, Palmer, & Coues. A stouter and larger-flowered form near San Antonio, New Mexico, Dr. Bigelow, in Whipple's Expedition. This species is to be distinguished from forms of the preceding with leafy stem and erect branches of the panicle by the long and delicate villosity of the bracteoles, and by the perigonium. The panicle is ample, but the branches erect or strict.

++ ++ ++ ++ Involucra sæpius brevi-campanulata, parva, perigoniis post anthesin auctis breviora, secus ramulos paniculæ nudæ plerumque intricatos sparsa, dentibus 4–5 latis rotundatis. Bracteolæ in involucro paleolatæ. Folia omnia subradicalia.

56. E. HEERMANNI, Durand & Hilgard in Pacif. R. R. p. 14, (Bot.) t. 17. Glaberrimum, vel forte glabratum, dichotomo-ramosissimum; involucris secus ramulos breves divaricatos paucis brevi-campanulatis lineam longis latisque plurifloris bracteas ovato-subulatas 2–3-plo superantibus; bracteolis glanduloso-ciliatis, exterioribus linearibus, intimis filiformibus; perigoniis glabris, fructiferis lin. 2 longis, segmentis exterioribus rotundatis interioribus oblongo-spathulatis multo majoribus; achenii rostro hirtello-scabro. *E. geniculatum*, Durand & Hilgard in Jour. Acad. Philad. 3, p. 45, non Nutt. — California, Posé Creek, Dr. Heermann. Sterile plains of Humboldt Co., Nevada, Torrey. Old flowering branches only; the base of the plant, leaves, and root not collected. But the species cannot be mistaken.

57. E. PLUMATELLA, Durand & Hilgard, l. c. t. 16. Flocccoso-lanatum, humile; foliis radicalibus orbiculatis longe petiolatis subtus albo-lanatis; paniculæ decompositæ ramis rigidulis floribundis nunc rectis nunc tortuosis demum implectentibus; involucro minimo campanulato paucifloro bracteas haud excedente; bracteolis filiformibus vix barbellatis; perigoniis albis et roseo-purpureis glabris lineam longis, segmentis conformibus (interioribus paullulum angustioribus vix longioribus) quasi panduriformibus; achenio sursum hirtello-scabrido. — Posè Creek, California, Heermann; apparently a stouter form than common. Nevada, chiefly in the desert, Anderson, Bloomer, Stretch, Torrey, Watson. A span high, or rarely taller, from an annual root; the panicles commonly forming implexed matted masses, their branchlets usually slender and rather brittle. Segments of the perigonium obovate-cuneiform and broadly retuse, when dry appearing panduriform by the incurving of their margins about the middle. Embryo much incurved, the cotyledons wholly accumbent.

Var. ? PALMERI: panicula patentissima; involucris cylindraceis fere lineam longis bracteas sæpius superantibus, floribus (albis) dimidio minoribus; bracteolis paucibarbatis. — Arizona, Dr. Palmer, 1869. This appears to be intermediate in character between *E. Plumatella* and *E. gracile*, and is perhaps of a distinct species. The flowers are like the former, except in size, or the segments a trifle narrower and perhaps the inner ones more decidedly longer.

58. E. INTRICATUM, Benth. Bot. Sulph. p. 46, t. 22. Foliis radicalibus suborbiculatis longe petiolatis viscoso-pubescentibus; panicula divaricato-ramosissima involucrisque minimis brevi-campanulatis paucifloris glaberrimis; bracteolis obovato- vel cuneato-oblongis ciliolatis; perigonii extus parce hirtelli segmentis obovatis conformibus; ovario glabro. — San Bartolomé, Lower California, Hinds. Bentham describes the perigonium as glabrous; but the scattered hairs on the outside of the perigonium are represented in the plate.

§ 12. PEDUNCULATA, Benth. Flos basi ipsa (lata rariusve acuta) cum pedicello articulatus. Ovarium glabrum. Involucra pauci-pluriflora, 5-dentata, omnia pedicellata, terminalia et alaria, solitaria: pedicelli sæpius elongati, in ramis 2–3-chotomis pedunculi aphylli parvi-bracteoli scapiformis laxe paniculati. Embryo præcedentium. Herbæ plerumque annuæ, foliis latis radicalibus vel in caule brevi sæpissime rotundatis, inflorescentia cum involucris nunquam pubescente, floribus plerumque albis seu albidis.

* Panicula divaricato-ramosissima glandulis claviformibus obsita: involucra pauciflora. Annua, scaposa, humilia. Ob pedicellos perbreves sp. sequentis *Virgatis* approximanda.

59. E. BRACHYPODUM, n. sp. Foliis rotundatis laxe albo-lanatis; panicula divaricatissima fere humifusa rigida; pedicellis involucro glanduloso 8–12-floro haud longioribus; bracteolis sublinearibus hirsuto-ciliatis; perigonii glabri segmentis exterioribus cordato-ovatis obtusissimis, interioribus dimidio minoribus ovatis longe obtuseque acuminatis. — Western borders of California, in alkaline sands around Kingston Spring, Remy, in herb. Mus. Paris. Branches of the panicle stouter and more rigid than in the next; the involucre and also the accrescent perigonium a line long.

60. E. GLANDULOSUM, Nutt. ex Benth. in DC. Foliis rotundatis viridibus parce pilosis; panicula tenui effusa; pedicellis capillaribus involucro eglanduloso perpaucifloro multoties longioribus; perigonii

segmentis oblongo-ovatis acutiusculis subæqualibus extus parce hirsutis. *Oxytheca glandulosa*, Nutt. Pl. Gamb. p. 170. — "Rocky Mountains of Upper California," according to Nuttall; an impossible habitat. Dr. Gambell probably collected it in New Mexico. Involucre and flowers half a line, the divaricate pedicels two or three lines long.

* * Panicula cum pedunculo et involucris (iis pedicellisque raro minutissime glandulosis) lævissima.

+ Effuso-ramosissima floribunda; pedicellis rigidis nunc subracemoso-secundis mox deflexis. Involucra pluriflora, circa lineam longa. Perigonium glaberrimum. Achenium rostro plus minus scabro. Annua; sp. prima etiam *Virgatis* approximanda.

61. E. DEFLEXUM, Torr. in Ives Colorado Exped. Bot. p. 24. Subvalidum; foliis omnibus radicalibus orbiculatis subcordatis floccoso-lanatis (majoribus sesquipollicaribus) longe petiolatis; paniculæ nunc ultrapedalis ramis rigidis junceis sæpius divaricatis; pedicellis brevissimis saltem involucro brevi-campanulato vel hemisphærico brevioribus; bracteolis (extimis lato-linearibus, intimis filiformi-spathulatis) barbato-ciliatis; perigonii albi basi obtusissimi segmentis exterioribus orbiculatis basi cordatis, interioribus minimis obovatis retusis multoties minoribus. — S. E. California, on the Colorado, &c., Schott, Newberry, Cooper. In sand, in a cañon of the Wasatch Mountains, Utah, S. Watson, in Clarence King's Expedition. Tucson, S. Arizona, Dr. Palmer: a form with the smaller involucres shorter than the pedicel. Involucre a line long and about as broad, rather many-flowered, the five teeth broad and rounded. Exterior segments of the perigonium becoming a line in length and breadth, the inner segments hardly longer than the ovary.

62. E. NUTANS, n. sp. Tenellum; foliis omnibus radicalibus rotundis floccoso-lanatis longe vel breve petiolatis; panicula effusa; pedicellis nutantibus cum involucro late campanulato 2-3-plo breviori minutissime viscoso-glandulosis; bracteolis filiformibus creberrime glandulosis; perigonii late rosei basi obtusissimi segmentis exterioribus late ovalibus emarginatis (fere obcordatis), interioribus oblongis retusis paullo brevioribus plus dimidio minoribus demum conduplicatis. — Nevada: cañon at the eastern base of the Sierra Nevada, Lieut. Beckwith; passed over in Pacif. R. R. 2, p. 129, as *E. cernuum*. Cañon in W. Humboldt Mountains and Unionville Valley, S. Watson in C. King's Expedition. The specimens at most are barely a span high;

the leaves half an inch in diameter, and the panicle rather simple. Involucre a line long and about as broad, rather few-flowered. Pedicels two or three lines long: perigonium as long, or at length longer.

63. E. Watsonii, n. sp. Gracile; foliis præcedentis sæpius subcordatis; panicula decomposita patentissima laxe floribunda; pedicellis eglandulosis patenti-deflexis involucro angusto- vel clavato-campanulato vix plurifloro 2 – 3-plo nunc paullo longioribus; bracteolis setaceis parce glanduloso-barbellulatis; perigonii albi vix rosei basi obtusi segmentis conformibus ovalibus parum retusis, interioribus paullulum minoribus. — Nevada, in the Humboldt Mountains, Torrey. Star Cañon, W. Humboldt Mountains, alt. 5,000 feet, S. Watson, in C. King's Expedition. The exceedingly effuse panicle spreads in the largest specimens over a foot in breadth. Pedicels much less deflexed than in the next, the longest fully three lines long, and nearly thrice the length of the involucre, but many of the later ones not longer than it, that is, a line or a line and a quarter in length, either smooth or very minutely and obscurely glandular. Perigonium a line long, or slightly more when accrescent, narrower than in *E. nutans*, and not so very broad at the base, but 6-parted, and not narrowed at base in the manner of the next.

64. E. cernuum, Nutt. Pl. Gamb. p. 162. Gracile; foliis radicalibus (nunc in caule brevi) orbiculatis vel obovatis sublonge petiolatis floccoso-lanatis; panicula effuso-decomposita sæpius maxime floribunda; pedicellis mox deflexis lævibus involucro campanulato 2 – 4-plo longioribus; bracteolis setaceis brevibus subundis; perigonii albi vel subrosei 6-fidi basi turbinata acuta segmentis exterioribus quadratis emarginatis retusis interiores oblonga dimidio angustiora vix superantibus. — Plains of the Platte to New Mexico and Utah. A span to a foot high; the panicle in the larger plants very widely spreading and floriferous. Involucre at most a line long. Flowers barely a line long when accrescent, often considerably less, smaller than any others of this sub-section, and well distinguished from all others of this section by the top-shaped base or tube, which is fully half the length of the segments and tapers to the narrow insertion.

Var. tenue: panicula graciliore minus florifera; pedicellis capillaribus elongatis (3 – 12 lin. longis), involucro minori vel tenuiori. — Nevada and Utah; foot-hills of the Humboldt and Wasatch Mountains, S. Watson, in Clarence King's Expedition. With just the flowers, &c. of *E. cernuum*, — this differs remarkably in the filiform looser

and scarcely rigid divisions of the panicle; the ultimate ones or pedicels less refracted, sometimes a full inch in length, commonly half an inch, and therefore many times longer than the fewer-flowered involucre.

+– +– Effusa, sæpius ramosissima, pedicellis nunquam deflexis. Involucra haud linea longora, interdum minuta, pauci–subpluriflora. Perigonium basi fere semper obtusissimum. Annua; folia radicalia vel subradicalia, rotundata, nunc basi cordata petiolata.

++ Subtus albo-lanata, supra plerumque floccosa. Perigonia involucro grossius 5 – 6-dentato haud longiora. Bracteæ sæpissime intus lanatæ.

a. Pedicelli breves (lin. 1 – 5 longi) cum panicula tota rigiduli. Perigonii glaberrimi segmenta maxime disparia.

65. E. ROTUNDIFOLIUM, Benth. in DC. l. c. Humile; foliis supra mox denudatis; panicula e collo ramosissima (spithamæa) rigidula floribunda; involucris late campanulatis subpluriﬂoris; bracteolis parce plumosis; perigonio albo glaberrimo parum ultra medium 6-*fido*, segmentis exterioribus flabelliformi-dilatatis retusis, interioribus anguste oblongis. — Western borders of Texas and adjacent parts of New Mexico, Wright, Bigelow, Thurber, Parry. Involucre seldom a line long, almost of the same breadth. Flowers three fourths of a line long, with a broadly campanulate base, and the outer segments much dilated upwards, so as to be usually much broader than long; the inner ones small and narrow.

b. Pedicelli tenues sæpissime capillares, alares semi–sesquipollicares. Perigonia basi tenuiter pilosula vel glabra. Herbæ tenellæ, cyma 2 – 3-chotoma tenera cum scapo spithamæa, in depauperatis subsimplici; foliis lamina semipollicari seu minori.

66. E. THURBERI, Torr. Bot. Mex. Bound. p. 176. Foliis rotundatis sæpius rugosis; scapo 1 – 2-pollicari primum lanuloso; bracteis 3 – 4-natis conspicuis calyculiformibus; involucro late turbinato-campanulato 10 – 18-floro; bracteolis vix ullis; perigonio albo (fructifero lineam longo) 5-partito basi brevi extus minutissime parceque hirsutulo, segmentis valde disparibus panduriformibus, exterioribus lobo terminali maximo rotundato (demum latiore quam longo) in centro tenuiter arachnifero, auriculis basim versus parvis, interioribus subhastato-lanceolatis parvulis superne vix dilatatis. — California, in sandy ravines near San Pasqual, Thurber. Los Angeles, Wallace.

S. Arizona, near Camp Grant, Palmer. — The minute pubescence at the base of the perigonium, and the tuft of most delicate cobwebby hairs on the centre of the disk of the exterior segments, have been overlooked. Pedicels and involucre often obscurely viscid-glandular; the latter a line long.

67. E. THOMASII, Torr. in Pacif. R. R. 4, p. 364. Foliis rotundatis ovatisque; bracteis ad nodos paniculæ effusæ minimis; involucro paucifloro; bracteolis paleaceis margine parce longe villosis; perigonio albo vel flavido (vix semilineam longo) basi tenuiter hispidulo, segmentis disparibus subpanduratis æquilongis apice parum dilatatis obtusissimis, exterioribus basi latiore demum subcordatis, interioribus dimidio angustioribus sublineari-oblongis. — Fort Yuma, S. E. California, Gen. Thomas; very slender specimens, not a span high, with almost capillary scape and panicle, also larger but less developed specimens: Fort Mohave (Fremont, locality not given), Cooper; larger specimens: Camp Grant, Arizona, Palmer; very slender form. Involucre little over half a line in length.

68. E. PUSILLUM, n. sp. Foliis rotundis obovatisque in petiolum sæpius angustatis; bracteis parvulis quaternis ad nodos basique paniculæ subsimplici; involucro fere hemisphærico 10 – 15-floro minutim glanduloso; bracteolis obovatis spathulatisque inferne laxe araneoso-lanatis; perigonio aureo (nunc purpureo tincto lineam longo (extus tenuiter glanduloso-puberulo profunde 5-partito, segmentis fere conformibus, exterioribus ovali-obovatis quam interiores oblonga paullo majoribus. — Foot-hills of Trinity Mountains, borders of the Truckee Desert, Nevada, S. Watson in C. King's Expedition. From two inches to a span high; the involucre barely a line long. To this probably belongs a specimen from "Bearside Mountain" in the same region, coll. Newberry; but the involucres are smaller and few-flowered; the flowers, however, "yellow."

69. E. RENIFORME, Torr. in DC. l. c. Foliis reniformi- vel cordato-orbiculatis dense mollissime albo-lanatis; bracteis parvulis lanatis; involucris late campanulatis haud glandulosis 8 – 12-floris; bracteolis præcedentis; perigonio ut videtur albo vel subroseo (semilineam longo) glabro, segmentis ovatis, interioribus paullo minoribus. — S. E. California, probably on the Mohave, Fremont. Fort Mohave, Cooper. Arizona, Palmer. All scanty and incomplete specimens. Involucre about a line long, sometimes seemingly much smaller and fewer-flowered.

++ ++ Folia pubescentia nunc glabrata, nunquam lanata vel tomentosa; petioli elongati. Perigonia flavula, extus crebre hirta, involucro minimo 4–5-fido paucifloro fere duplo longiora, segmentis conformibus subæqualibus. Bracteæ haud lanatæ. Panicula e scapo rigidulo sæpe fistuloso effuso-ramosissima, elatior, pedicellis divaricatis capillaribus tenuissimis (semi–ultrapollicaribus) glaberrimis involucris multoties longioribus.

70. E. TRICHOPODUM, Torr. in Emory, Rep. of Reconn. p. 151, 1848 (perperam *E. trichopes*), Benth. in DC. l. c. Foliis tenuiter pubescentibus vel supra glabris ovalibus rotundisve nunc subcordatis; paniculæ ramis elongatis cum scapo brevi vel brevissimo rigidulis; pedicellis tenuissimis; involucro semilinea sæpius breviore; perigonii segmentis ovato-lanceolatis. — S. W. Texas through New Mexico and Arizona to S. E. California. In the stronger specimens the scape is more or less fistulous, but not inflated, and, with the very branching panicle, from one to two feet high.

71. E. INFLATUM, Torr. in Frem. 2^d Rep. & in DC. l. c. Foliis hirsuto- seu velutino-pubescentibus nunc glabratis orbiculatis vel rotundo-cordatis; scapo elongato superne fusiformi-inflato; paniculæ ramis rigidulis inferne longe nudis, primariis raro inflatis; pedicellis capillaribus; involucro semilinea nunc subbreviori nunc longiori; perigonii segmentis ovatis (demum lineam longis). — In dry or desert districts of California, Arizona, and Nevada. *E. cordatum*, Torr. in DC. l. c. (of which the specimens are lost) is doubtless a glabrate and depauperate state of this species, or possibly of the foregoing. The two are disposed to run together.

++ ++ ++ Folia utrinque glabra (an glabrata?) ut tota planta. Perigonia involucro vix lineam longo paucifloro longissime pedicellato haud longiora.

72. E. GORDONI, Benth. in DC. l. c. Foliis subcoriaceis rotundis glabris; pedunculis e radice pluribus brevibus in paniculam repetite dichotomam laxam divisis, ramis gracilibus; pedicellis subcapillaribus ultrapollicaribus erectis; involucro turbinato-campanulato 5-dentato; perigonii glaberrimi (albi vel subrosei?) segmentis exterioribus ovatis interiora oblonga paullo superantibus; bracteolis minute glandulosis. — "In the Rocky Mountains on the Platte, Gordon," in herb. Hook.: found only by Gordon, and in specimens nearly past flowering. About

a foot high, with sparse involucres. Fresh specimens of this little-known species are most desirable. The root plainly is not perennial.

+ + + Minus ramosa nunc oligocephala, pedicellis elongatis erectis. Involucra $1\frac{1}{2}-2\frac{1}{2}$ lin. longa, pluri-multiflora. Perigonium glabrum, basi brevi turbinata. Bracteæ minimæ. Bracteolæ in involucro villosæ. Perennia seu biennia, foliis haud cordatis.

73. E. TENELLUM, Torr. in Ann. Lyc. N. Y. 2, p. 241. Caudice suffruticoso multicipiti cæspitosum; foliis confertissimis ovatis nunc rotundis longius petiolatis utrinque albo-tomentosis; scapo seu pedunculo ramis paniculæ 2-3-dichotomæ sparsis pedicellisque elongatis gracillimis lævibus; involucro turbinato-campanulato ($1\frac{1}{2}-2$ lin. longo) vix plurifloro; perigonio petaloideo albo 6-partito, segmentis disparibus retusis vel emarginatis, exterioribus late obovatis seu orbiculatis quam interiora lineari-oblonga paullo breviora post anthesin conniventia multo majoribus. — Colorado, at the base of the Rocky Mountains to N. New Mexico and W. Texas. The original *E. tenellum*, which deserves the name, is the smallest and most slender, wholly acaulescent form, coll. in Colorado and New Mexico by James, Emory, Fendler, Bigelow, and Parry; the scape with the rather simple panicle hardly a foot high, the blade of the leaves less than half an inch long, the flower a line or in fruit a line and a half in length. Var. *leptocladon*, Benth. (W. Texas, Wright), is simply larger and more robust, the ampler and more compound panicle attaining a foot and a half or two feet in height.

Var. CAULESCENS (var. γ. *ramosissimum* & *E. platyphyllum* (Torr.), Benth. in DC.): ramis e caudice lignescente adsurgentibus (4-10 poll. longis) foliosis; foliis sæpe majoribus lamina nunc ultra semipollicari; panicula ampliore floribunda; involucro et perigoniis fructiferis lin. $1\frac{1}{2}-2$ longis. — W. Texas, Riddell, Wright, Lindheimer, and Parry; specimens collected by the latter passing into the ordinary *E. tenellum* by the scapelike peduncle and small panicle.

74. E. CILIATUM, Torr. in DC. l. c. Radice bienni seu annua; foliis radicalibus rosulatis obovato-spathulatis in petiolum marginatum attenuatis præter margines costamque barbato-ciliatos glabris; scapo pedunculisque paucis elongatis; involucro late campanulato multifloro (lin. 2 longo); perigonio atro-rubente crassiusculo 6-fido basi turbinato, segmentis ovatis acutis, interioribus post anthesin paullo angustioribus

longioribusque. — Northern Mexico; in the vicinity of Buena Vista, Edwards; Monterey, Gregg.

§ 13. PSEUDO-STIPULATA (*Substipulata*), Benth. Flos basi obtusissima cum pedicello articulatus, extus minute glandulosus. Ovarium glabrum. Achenium acute triquetrum. Involucra sæpiusque pedicelli *Pedunculatorum*. Caules ramosi foliati, sed folia rite evoluta semper secundaria, nempe in axillis caulinorum ad bracteas oppositas seu 3 – 4-nas stipulæformes redactorum gemina vel fasciculata. Embryo præcedentium. Herbæ.

* Involucra sublonge pedicellata, multiflora, 5-dentata, dentibus brevibus latis. Flores in pedicellis brevibus haud ultra bracteolas exserti.

75. E. ANGULOSUM, Benth. Eriog. p. 406, t. 18, f. 1. Annuum, floccoso-lanosum, demum glabrescens; caulibus erectis in paniculam effusam repetito 2 – 3-chotomam divisis; ramis acute 4 – 6-angulatis; pedicellis filiformibus patentissimis; foliis radicalibus spathulatis vel rotundatis, caulinis propriis bracteæformibus parvis stipulas brunneo-scariosas mentientibus, axillaribus geminis vel fasciculatis oblongo-linearibus lanceolatisque; involucris brevi-campanulatis seu hemisphæricis minute glandulosis nunc fere lævibus; fructiferis demum explanatis bracteas internas (potius quam bracteolas) inferne lanigeras late spathulatas vix adæquantibus; perigonio roseo vel albo profunde 5-partito, segmentis exterioribus ovatis concavis, interioribus demum longioribus lanceolato-oblongis. — California and Nevada, apparently common. A span to a foot high, at length diffuse. Pedicels from six to twelve lines long. Flowers barely one line long, on slender internal pedicels which do not exceed the firm dilated bracts that subtend them; the proper bractlets minute and capilary, and villose-plumose or often wanting.

76. E. GREGGII, n. sp. Subpedale, e radice perenni erectum, puberulum, subglandulosum; foliis radicalibus et fasciculorum spathulatis in petiolum marginatum attenuatis subciliatis glabellis (petiolis nunc parce hirsutis), caulinis 3 – 4-nis lanceolatis brevibus herbaceis in ochream basi connatis; pedicellis subracemosis erectis, inferioribus ultrapollicaribus; involucro turbinato-campanulato; bracteolis tenuibus hirsutis; perigonio purpurascente profunde 6-fido, segmentis conformibus ovato-oblongis. — N. Leon, Mexico, on a high plain near San Juan de la Vaqueria, Gregg. Has been taken for a variety of *E. ciliatum*,

(and is mentioned in DC. Prodr. in a note under that species); but it is very different. Flowering stems rather simple and rigid, bearing fascicles of leaves in most of the axils. Involucre two lines long; the larger of the contained bracts and bractlets lanceolate and scarious; the others filiform. Pedicels of the flower apparently compressed, little exceeding a line in length, and about the length of the perigonium.

* * Involucra alaria pleraque sessilia, minima, fere 5-partita, pauciflora.

77. E. DIVARICATUM, Hook. Kew Jour. Bot. 5, p. 265; Benth. in DC. l. c. Annuum, demissum, a basi divaricato-ramosissimum, minute pubescens; foliis radicalibus ovatis spathulatisque longius petiolatis, caulinis secundariis intra primaria parva stipulæformia subulato-linearia geminis conformibus superne gradatim minoribus; perigonii albidi segmentis oblongis subæqualibus. — Utah, on saline clayey soils, within the high calcareous hills of the Upper Colorado, Geyer. Less than a span high. Lamina of the leaf from six to three, or the ultimate ones only one or two lines long. Flowers little over half a line in length. All the developed leaves on the stem and branches appear to spring from within the stipule-like true cauline ones.

§ 14. FOLIOSA, Benth. Flos basi brevissima acutata vel obtusa perigonii 5-partiti cum pedicello exserto articulatus. Ovarium glabrum. Involucra 4–8-fida vel partita, nunc in pedicellis paniculata vel subracemosa modo *Pedunculatorum*, nunc in dichotomiis sessilia. Caules foliosi: folia caulina rite evoluta, opposita seu verticillata (ima tantum alterna) et in axillis fasciculata. Embryo præcedentium. Herbæ annuæ.

* *Salsuginosa:* involucri phylla fere discreta inæqualia. Perigonium fructiferum achenio acutissime triquetro arcte conforme.

78. E. SALSUGINOSUM, Hook. Kew Jour. Bot. 5, p. 264. Glabrum, diffuso-ramosissimum, usque ad apicem foliosum; foliis subcarnosis, imis spathulatis oblongisve, superioribus linearibus; involucris alaribus sessilibus paucisve ramulos seu pedunculos filiformes terminantibus paucifloris e bracteis linearibus basi subcoalitis vel discretis; floribus subsessilibus; perigonio subherbaceo extus minute hirtello, segmentis oblongis subæqualibus apice tantum scariosis. — Utah, in the Rocky Mountains near the sources of the Colorado, on saline clayey soils,

Nuttall, Geyer. An inch to a span high. Perigonium in fruit barely a line long.

* * *Rumiciflora:* involucra plus minus pedunculata, multiflora, profunde 5–8-fida, lobis linearibus foliaceis. Perigonii petaloidei segmentis disparibus, exterioribus basi cordatis. Folia inferiora lata.

79. E. Abertianum, Torr. in Emory, Reconn.; Benth. in DC. l. c. Villosum seu laxe molliterque pubescens, paniculato-ramosum; ramis fere ad apicem sæpius foliatis erectis; foliis inferioribus ovatis vel subcordatis longius petiolatis sæpius undulatis, ramealibus lanceolatis linearibusve subsessilibus; pedunculis alaribus inferioribus plerumque gracilibus, superioribus involucro æquilongis vel brevioribus; perigonii glabri rosei segmentis exterioribus orbiculatis sinu profundo clauso cordatis quam interiora lineari-oblonga subpandurata apice retusa multo latioribus. — W. Texas (Wright) to Chihuahua, Arizona, &c.: apparently common. A span to a foot high, very variable in size, foliage, &c. The enlarged exterior segments of the perigonium become nearly two lines long, the lobes at the deeply cordate base covering the small and narrow tube of the perigonium.

* * * *Spergulina:* involucra effuso-paniculata in pedicellis lævibus capillaribus, parva, pauciflora, 5–8-fida. Perigonia petaloidea, segmentis haud cordatis. Caules gracillimi, internodiis elongatis: folia caulina angusto-linearia, marginibus nunc revolutis.

80. E. pharnaceoides, Torr. in Sitgreaves Rep. p. 167, t. 11, & in DC. l. c. Pubescens; foliis subtus cano-tomentosis supra glabrescentibus; involucris 5–8-fidis 8–12-floris; bracteolis filiformibus villosis; perigonio glabro albo vel roseo, segmentis exterioribus latissime ovatis concavis, fructiferis basi bigibbosis quam interiora oblongo-linearia retusa brevioribus; antheris nigricantibus. — New Mexico and Arizona, Wright, Bigelow, Sitgreaves, Thurber, Coues and Palmer. Commonly about a foot high; with leaves about an inch long and a line or less in width. Pedicels one or two inches, and involucre one or two lines long. Perigonium when accrescent a little over a line in length.

81. E. spergulinum, Gray in Proceed. Amer. Acad. 7, p. 389. Tenuius; foliis cum basi caulis parce hirsutis glandulosisque utrinque viridibus; panicula magis effusa, pedicellis tenuissimis; involu-

cris minimis 4-fidis sesquifloris glabris; bracteolis nullis; perigonio albo basi pilosulo, segmentis æqualibus cuneato-oblongis, exterioribus obtusis vel retusis, interioribus apice truncato pl. m. eroso-tridentatis. — California, in the Mariposa Grove, &c., Bridges, Brewer, Bolander. Nevada, Anderson, Bloomer. Pedicels seldom more than an inch long, truly capillary. Involucre only half a line, but the flower a line or with age a line and a half long: usually only one is developed, but there is always a rudiment of a second flower. Achenium lenticular.

3. OXYTHECA, Nutt. p. p., Benth. in DC. l. c.

Involucrum pauciflorum, cyathiforme, 4-fidum, lobis aristatenui superlatis. Flores, bracteolæ, etc. *Eriogoni.* Achenium lenticulare. Radicula longa cotyledonibus orbiculatis accumbens. — Annuæ, Californicæ, unica e Cordilleras Chili et Mendozæ, divaricato-ramosissimæ, laxifloræ, ramis teneribus glandulis parvis pedicellatis hinc inde conspersis. — Genus *Eriogono* proximum, nunc speciebus novis confirmatum.

* Involucra omnia pedicellata; pedicellis alaribus saltem inferioribus gracillimis nudis. Folia bracteæque tantum mucronatæ.

1. O. DENDROIDEA, Nutt. Pl. Gamb. p. 169; Benth. l. c. Effuse cymoso-ramosissima; foliis radicalibus lanceolatis seu lineari-lanceolatis hirsutulis, caulinis bracteisve gradatim diminutis basi nunc subconnatis; aristis involucri sæpe inæqualibus. — Forma tenuior floribunda est *Brisegnoa Chilensis*, Remy in Gay Fl. Chil. 5, p. 292, tab. 58, et *Tetraraphis apiculata*, nunc *Oxytheca apiculata*, Miers. Forma vegetior magis foliata, floribus sparsis, *O. foliosa*, Nutt. l. c. — This larger foliose form was collected in Nevada near Empire City by Dr. Torrey, and recently, in Clarence King's Expedition, by S. Watson, who also gathered in abundance in the Douglas Range, Nevada, a very slender and exceedingly floriferous form, quite like the South American. All Nuttall's specimens we have seen are intermediate between the two. The involucres vary from half a line to nearly a line in length, not counting the awn, upon the length of which no dependence can be placed.

* * Involucra subsessilia vel bracteis plus minus connatis suffulta.

2. O. WATSONI, n. sp. Effuse ramosissima; foliis radicalibus spathulatis pubescentibus; bracteis ovatis seu ovato-lanceolatis basi tantum sæpius hinc connatis, superioribus decrescentibus lobisque involucri aristis suis rigidis dimidio brevioribus. — Monitor Valley, Nevada, Sereno Watson in C. King's Expedition, July, 1868. A span to ten inches high. Radical leaves an inch or more long, much broader and blunter than those of the foregoing species. Lower bracts about two lines long, rigid, mostly decurved, their bases commonly connate on one side. Pedicels not more than half a line long, about the length of the body of the involucre they support, or when apparently lengthened then bibracteolate near their apex: the awns of these upper bracts and of the about three-flowered involucre a line and a half or two lines in length. Fruit not seen.

3. O. PERFOLIATA, n. sp. *Chorizanthis perfoliatæ* admodum similis, demissa, divaricato-ramosissima; foliis glaucescentibus (sæpe rubentibus in sicco chartaceis), radicalibus spathulatis, caulinis bracteisve sursum vix decrescentibus (internodio dimidio brevioribus), in centro perfoliatis disciformibus subtrigono-orbiculatis venulosis triaristulatis; involucris in dichotomiis sessilibus solitariis, lobis subulato-lanceolatis aristis suis æquilongis. — Nevada, Fremont, second Expedition. Unionville, Humboldt, and Truckee valleys, on the borders of the desert, May to July, 1868, S. Watson in C. King's Expedition. A most remarkable species, uniformly leafy to the tips of the branches, or only the latest cauline or rameal leaves or bracts much reduced in size: these are all centrally perfoliate disks, from half an inch to nearly an inch in diameter, manifestly composed of a whorl of three wholly connate leaves, the slender short awns answering to their tips; at the first fork, however, there is commonly an involucre-like whorl of three or four small leaves, connate only at the base. Involucre a line and a half long exclusive of the rigid awn, which is a prolongation of a much more conspicuous costa than in the other species. Flowers from four to six, conspicuously pedicellate. Perigonium pubescent, its segments ovate and acute. Achenium turgidly ovate-lenticular, pointed: cotyledons thickish.

4. CENTROSTEGIA, Gray in DC. l. c.

Involucrum 1 – 3-florum, tubulosum, 5 – 6-dentatum, basim juxta 3 – 6-calcaratum, calcaribus divaricatis dentibusque cuspidatis seu aristatis. Flores, fructus, etc. *Chorizanthis;* foliato et inflorescentia

laxa sect. *Mucroneæ.* — Annuæ, Californicæ, demissæ, fere glabræ, foliis radicalibus spathulatis, ramealibus bracteisve sæpius trifidis, lobis aristulatis, involucris subsessilibus. Genus inter *Chorizanthem* (*Mucroneam*) et *Oxythecam.*

1. C. THURBERI, Gray, l. c. Glabra; involucro 1–2-floro chartaceo venuloso apice tantum 5-dentato, costis haud prominulis, calcaribus 3 grossis conicis dentibusque ovatis breviter cuspidatis; perigonii segmentis lineari-spathulatis basin versus hirsuto-ciliatis. (Embryo incurvo-excentricus, radicula longa.) San Felipe, Thurber, who alone has met with it.

2. C. LEPTOCERAS, Gray *in* herb. Kew. Glabella; ramis divaricatis; involucro hirsutulo 2–3-floro 6-fido, dentibus lanceolato-subulatis aristatis (arista unico longiore), calcaribus 6 aristiformibus apice uncinatis tubo dimidio brevioribus; perigonii segmentis ovalibus dorso parce pilosis. — Plains of San Gabriel, Lobb in herb. Kew.

5. CHORIZANTHE, R. Br.

Involucrum uniflorum, gamophyllum, basi inappendiculatum, tubo sæpius angulato vel costato, dentibus lobisve 2–6 fere semper cuspide vel arista terminatis sæpius inæqualibus. Flos inclusus vel parum exsertus, in involucro subsessilis seu breviter pedicellatus. Perigonium tenue vel corollinum, 6-lobum vel 6-partitum. Stamina 9, raro 3 vel 6. Achenium trigonum. Embryo *Eriogoni*, nunc rectus cotyledonibus angustioribus, nunc incurvo-excentricus vel cotyledonibus latis radiculæ pl. m. accumbentibus. — Plantæ humiles, involucris sessilibus cymoso-congestis vel sparsis, foliis oppositis verticillatisque seu inferioribus sæpius alternis. — *Chorizanthe* & *Mucronea*, Benth. Eriog. & in DC. l. c. *Acanthogonum*, Torr.

§ 1. EUCHORIZANTHE. Involucrum tubulosum, 6-dentatum, 6-costatum, angulatum, sæpius coriaceum, costis validis in cuspidem vel aristam sæpius pl. m. uncinatam excurrentibus. Stamina juxta basim perigonii 6-lobi inserta. Folia nunquam cordata, integra, saltem caulina angusta basi attenuata.

* Annuæ, Californicæ, *Scariosæ,* nempe involucris in glomerulas capituliformes congestis, limbo pl. m. albo-scarioso (necnon præcocibus vegetioribus in dichotomiis primariis solitariis ex toto herbaceis).

+ Involucri limbus omnino præter costas petaloideo-scariosus, rotato-expansus, breviter 6-lobus. Caulis erectus: capitula densa.

1. C. MEMBRANACEA, Benth. Eriog. l. c. p. 419, t. 7, f. 1. Araneoso-lanata; foliis bracteisque conformibus linearibus mucrone debili; capitulis solitariis paucisve secus ramos subsimplices dissitis, fructiferis iis *Scabiosarum* similibus; involucro præter basim et costas validas in aristulam excurrentes prorsus scarioso, limbo maxime dilatato. — Not rare in California; a most marked species.

2. C. STELLULATA, Benth. Pl. Hartw. no. 1937. Hirto-pubescens, fastigiato-ramosa; foliis caulinis fere linearibus; bracteis acerosis pungenti-aristulatis pilis rigidioribus hirsutis; capitulis subcymosis; involucri tubo angusto insigniter æqualiter 6-costato (lin. 2 longo), limbo abrupto præter costas validas in aristulam excurrentes toto albo-scarioso quadruplo longiore; perigonii segmentis obcordato-bilobis; antheris oblongo-linearibus. — Known as yet only in Hartweg's collection from the valley of the Sacramento.

3. C. DOUGLASII, Benth. Eriog. l. c. Humilis, villoso-pubescens; foliis caulinis spathulatis seu spathulato-lanceolatis; bracteis acerosis pungentibus; capitulis sæpius umbellatis globosis; involucri circa lin. 2 longi tubo inæqualiter angulato limbo brevi abrupto (albo vel roseo) cum aristis subulatis inæqualibus 2 – 3-plo longiore; perigonii segmentis apice truncatis subcrenulatis; antheris lineari-oblongis. — The genuine *C. Douglasii* has apparently been collected only by Douglas, and lately by Prof. Brewer, — by the latter on very dry hills in Santa Margarita Valley, sparingly and in depauperate specimens. The expanded scarious limb of the involucre, when not torn down, is angulate-lobed in the manner of the preceding, i. e. the stout costæ which project as awns are connected high up by the scarious membrane. Bentham's var. *Hartwegi* must be united to *C. pungens*.

+ + Involucri limbus 5-partitus, nempe dentibus ad faucem usque discretis aut margine aut fere toto albo-scariosis. Caules laxi, a basi ramosi, sæpius diffusi; pube plus minus villosa: capitula plerumque irregulariter paniculata: bracteæ pungenti-aristatæ, supremæ aristiformes. — Adsunt fere semper involucra pauca præcociora solitaria dentibus accrescentibus herbaceis immarginatis.

4. C. DIFFUSA, Benth. Pl. Hartw. no. 1938. Pilosula, tenella; foliis plerisque radicalibus spathulatis seu oblongo-ovatis (cum petiolo 4 – 12

lin. longis); glomerulis parvis laxiusculis; involucro haud ultra lineam longo, dentibus ovatis præter costam toto scariosis cum aristis (1 – 2 multo majoribus tubum adæquantibus) inæqualibus; antheris ovalibus. — Monterey, on dry and sandy plains, Hartweg; near the sea-beach, Parry (in herb. Torr.), the specimens of the latter less pubescent and more floribund.

5. C. PUNGENS, Benth. Eriog. l. c. t. 19. Molliter hirsuto-villosa; caulibus plerumque diffusis ramosis inferne foliatis; foliis spathulatis vel sublanceolatis; glomerulis irregularibus; involucro (lin. 1½ – 2½ longo) dentibus basi herbaceis nunc latissime nunc angustius scarioso-marginatis ovatis nunc ovato-subulatis inæqualibus, majoribus bracteisque longius pungenti-aristatis; antheris oblongis. — Apparently the commonest species along and near the coast of California, and most variable in size; the larger forms coarse, with the thickish stems or branches a foot or two long; the depauperate forms slender, sometimes no more than two or three inches high. The scarious margins of the teeth of the involucre are commonly very broad and thin, but occasionally narrow and inconspicuous in the dry state. *C. Douglasii*, var. *Hartwegi*, Benth. in DC. (*C. nudicaulis*, Benth. Pl. Hartw. no. 1935, non Nutt.) is one of the stout and more upright forms of this species, with broad and rounded scarious teeth, distinct, however, quite to the base. *C. angustifolia*, Nutt., Benth. in DC., is one of the depauperate forms of *C. pungens*.

* * Annuæ, Californicæ cum unica Chilensi, *immarginatæ*, dentibus involucri ex toto herbaceis vel coriaceis sæpe corniformibus, sinubus tantum scariosis.

+ Cymoso-confertifloræ, involucris in cymulis glomerulisve confertis cum alaribus solitariis in dichotomiis. Stamina (spec. ultima excepta) 9.

++ Perigonii segmenta infra apicem pectinato-fimbriata. Erectæ, scaposæ, pedunculo nudo in cymam repetito-2–3-chotomam diviso, foliis omnibus radicalibus spathulatis ovalibusque, bracteis aceroso-subulatis, flore in involucro sessili.

6. C. LACINIATA, Torr. in Pacif. R. R. 7, Bot. p. 19. Nana, subvillosa; cyma floribunda; involucri dentibus subulato-aristatis fere æqualibus tubo 2 – 4-plo brevioribus; perigonio involucro duplo longiore, segmentis triangulari-lanceolatis longe crebreque fimbriatis apice

caudatis. — San Felipe, California, Dr. Antisell, in Parke's Expedition. The beautifully fringed and conspicuously tail-pointed segments of the perigonium are commonly exserted two lines beyond the orifice of the involucre.

7. C. FIMBRIATA, Nutt. Pl. Gamb. p. 168; Torr. in Pacif. R. R. 5, Bot. t. 8. Humilis, subvillosa vel glabella; involucri dentibus validis subulatis aristatis tubo paullo vel dimidio brevioribus; perigonio minus exserto, segmentis infra apicem oblongum obtusum irregulariter lacero-fimbriatis. — Abundant on dry hills near San Diego, Nuttall, Parry, Thurber, &c., and east to the Mohave River, Thomas, Cooper, &c. This was collected by Botta many years ago, from whose specimens, preserved at the Jardin des Plantes, a drawing was long ago made by Decaisne and engraved for Mirbel, who was to have published Botta's collection.

++ ++ Perigonii segmenta integerrima vel apice tantum crenulata. Caules subundi.

8. C. STATICOIDES, Benth. Eriog. l. c. Erecta (bipollicaris ad pedalem); foliis plerisque radicalibus spathulatis oblongis rotundisve hirsutulis subtus plerumque tomentosis; cyma effuse corymbosa; involucri dentibus subulatis breviter aristatis seu aristulatis, inæqualibus, majoribus tubo angusto 2 – 3-plo brevioribus. — *C. nudicaule* & *C. discolor*, Nutt. l. c. From San Luis Obispo and Santa Barbara County, Brewer, Torrey, to San Diego, Nuttall, &c., and Fort Tejon, Xantus (published as *C. procumbens*).

9. C. PROCUMBENS, Nutt. l. c., Benth. in DC. Demissa, subhirsuta; foliis spathulatis; ramis (poll. 2 – 4 longis) diffusis vel decumbentibus; cymulis irregularibus paniculatis; involucri dentibus corniformibus subulato-aristatis, 2 – 4 majoribus tubo parum brevioribus. *C. uncinata*, Nutt. l. c. — San Diego, &c., Nuttall, Thurber, Blake. A depressed plant, very fragile with age, and the awns more constantly uncinate than in related species. Tube of the involucre barely a line long.

10. C. UNIARISTATA, n. sp. Diffusa, pube molli subcinerea; foliis spathulatis subtus piloso-pubescentibus; cymulis laxiusculis; bracteis aristatis; involucri dentibus corniformibus, unico arista recta valida tubo brevi-oblongo paullo vel subduplo longiore, cæteris cuspide brevi superatis; staminibus 3. — New Idria, California, in very dry places, Brewer. Achenium slender. Embryo straight or very

slightly incurved: cotyledons linear-oblong, nearly twice the length of the radicle.

+- +- Paniculato-laxifloræ. Stamina 3 – 6.

11. C. BREVICORNU, Torr. Bot. Mex. Bound. p. 177. Cinereo-puberula, subspithamæa; foliis plerisque radicalibus nunc linearibus nunc obovato-spathulatis; bracteis parvulis uncinato-mucronatis; involucris angustis prismaticis secus ramos subsimplices paniculæ plerisque dissitis, dentibus subæqualibus subulato-aristulatis recurvis tubo (lin. 2 – 3 longo vix semilineam lato) 3 – 5-plo breviore; perigonii lobis integerrimis; staminibus 3. — S. E. California to the Gila and Nevada, Fremont, Parry, Newberry, Watson, the latter from Truckee Valley, near the desert, and different from other specimens in the spatulate-obovate instead of almost linear leaves. No well-developed or exserted flowers seen.

12. C. COMMISSURALIS, Remy, Fl. Chil., the only annual species not North American, is most related to *C. brevicornu,* is similar in habit and inflorescence, and in the narrow involucre, but is more downy. The flowers examined have six stamens, and are not quite sessile in the involucre. Embryo straight; cotyledons narrow.

* * * *Perennes* suffrutescentes, Chilenses, involucris corymboso-glomeratis, dentibus herbaceis quandoque muticis.

13. C. VIRGATA, Benth., 14. C. PEDUNCULARIS, Benth., 15. C. MACRÆI, Benth., 16. C. RAMOSISSIMA, Benth., 17. C. PANICULATA, Benth., 18. C. VAGINATA, Benth., 19. C. FRANKENIOIDES, Remy, 20. C. GLABRESCENS, Benth.; vide DC. Prodr. 14, p. 24. Of these Chilian perennial species we have nothing to remark. Most of them have a pretty long cylindraceous tube to the perigonium, on which the stamens are borne either below the middle or near the base.

§ 2. MUCRONEA. Involucrum 2 – 4-quetrum, 2 – 4-lobatum, chartaceo-coriaceum, lobis herbaceis arista recta superatis. Stamina 9, basi perigonii 6-partiti inserta. Annuæ, Californicæ, nunquam tomentosæ, divergenti-ramosissimæ, involucris in dichotomiis et secus ramulos graciles paniculatos sparsis, foliis in sicco pergameceis, caulinis bracteisque conformibus sursum sensim minoribus amplexicaulibus pl. m. stellato-trilobis, lobis cuspidatis vel aristatis. Flos in involucro breviuscule seu longiuscule pedicellatus.

21. C. PERFOLIATA, Gray in Proceed. Bost. Soc. Nat. Hist. 1860. Hirsutula, subglandulosa seu glabella; foliis caulinis perfoliatis; involucro tetraquetro quadridentato, dentibus breviter inæqualiter subulato-aristatis; perigonii segmentis versus apicem laciniatis. (Embryo rectus.) — Fort Tejon, California, Xantus. On very dry rocky hills, near San Luis Obispo and Mt. Oso, Brewer. "Whole plant turning bright scarlet."

22. C. CALIFORNICA, Gray, l. c. Hirsutior; foliis caulinis amplexicaulibus, superioribus alte trilobis; involucro compresso sæpissime bilobo subæqualiter biaristato, rarius 3–4-quetro aristis additis brevioribus; perigonii segmentis integerrimis. *Mucronea Californica*, Benth. Eriog. p. 416, t. 20. — Found, so far as we know, only by Douglas, Nuttall, and Parry, and only in the vicinity of San Diego. In Parry's specimens the angles and teeth of the involucre are commonly three or four.

§ 3. ACANTHOGONUM. Involucrum 3–5-dentatum seu lobatum, coriaceum, tubo transverse venuloso vel corrugato, lobis inæqualibus immarginatis. Stamina 6–9, fauci perigonii 6-lobi inserta: filamenta brevia: antheræ breves. Annuæ, Californicæ, nanæ, foliis ovatis spathulatisve integris petiolatis muticis, involucris pl. m. glomeratis. Flos in involucro pedicellatus, tenuiter bracteolatus.

The genus *Acanthogonum*, Torr., seemed to rest securely upon its three-lobed and angled involucre, the faucial insertion of the stamens, and the remarkable spiny bracts. But a second species was afterwards added with a terete involucre; and now we must associate with these two others which in different ways connect with *Chorizanthe*, leaving only the character of the insertion of the stamens, — which, moreover, in *A. corrugatum*, is not quite so high as in the others, while in some Chilian species of *Chorizanthe* they are borne rather far up on the tube.

* Involucrum late triquetrum, tricostatum, dentibus lobisve 5: bracteæ innocuæ.

23. C. POLYGONOIDES, n. sp. Diffuso-ramosissima, depressa, laxe hirsuto-pubescens; foliis bracteisque spathulatis petiolatis muticis, summisve minimis tantum mucronatis; involucris laxius paniculato-glomeratis demum induratis obpyramidato-triquetris tricostatis, lobis 3 triangulato-subulatis in aristam spinescentem apice subhamatam desi-

nentibus cum 2 intermediis parvis vel minimis; staminibus 6, filamentis brevissimis. — "Reservoir Hill," Placerville, California, Mr. Rattan. An insignificant weedy plant, three or four inches high, the branches when old fragile at the joints, as in many other species, in habit resembling *C. procumbens.* Fruiting involucre with its broadly obpyramidal tube a line and a half long, glabrate; the longer and widely divergent lobes with the pungent stout awn about the same length, or even longer; the two intermediate and much smaller pungent-pointed teeth not arising from any obvious costæ. Tube of the perigonium cylindraceous; the stamens some of them opposite and some alternate with the lobes. Achenium and seed ovate-pyramidal. Embryo as in the following.

* * Involucrum trigonum, 6-costatum, trifidum: bracteæ spiniformes.

24. C. RIGIDA. Pygmæa, primum lanata; caule ($\frac{1}{2}$–2-pollicari) parum ramoso demum crassiore lignescente; foliis ovatis seu obovatis subtus albo-tomentosis longe petiolatis; involucris in axillis sessilibus solitariis vel confertis bracteis elongatis aristæformibus seu lanceolatis spinescenti-cuspidatis demum induratis suffultis, lobis 3 inæqualibus ovato- seu triangulari-lanceolatis cuspide spinescente recta terminatis tubo brevi-campanulato (majore duplo) longioribus; perigonii tubo cylindraceo basi obtuso; staminibus 9. *Acanthogonum rigidum,* Torr. Pacif. R. R. 4 (Bot. Whipp.), p. 132, & 5, p. 365, & Bot. Mex. Bound. p. 177 (excl. ref. "tab. 8"). — On the desert of S. E. California and the neighboring parts of Arizona and New Mexico, Bigelow, A. B. Gray, Thomas, Newberry, Cooper, Parry; also Nevada as far north as Truckee Valley, Watson. The older plants horrid with the tufted bracteal spines, of which the larger are about an inch in length. Stamens perhaps always 9. The older involucres thin and scarious between the reticulations. Cotyledons orbicular, accumbent on the base of the slender curved radicle.

* * * Involucrum tubo tereti angusto, costis obsoletis, dentibus 3 vel 5 cum bracteis parvulis breviter cuspidatis. Herbæ exiles, caule 1–3-pollicari demum subcymoso-ramoso.

25. C. CORRUGATA. Albido-lanata; foliis ovatis seu ovali-rotundis longe petiolatis; involucris demum subcymosis, lobis 3 ovato-lanceolatis cum bracteolis herbaceis cuspide recurva apiculatis tubo subclavato eximie corrugato (fructifero fere tuberculato) sublongioribus; tubo perigonii basi attenuato; staminibus 6–9. *Acanthogonum corruga-*

tum, Torr. Pacif. R. R. 5, p. 364. — In the same district as the preceding, near Fort Yuma, Gen. Thomas. Tube of the involucre nearly two lines long, cylindrical with an attenuated base.

26. C. Watsoni, n. sp. Canescenti-pubescens; foliis angusto-spathulatis lanceolatisve; involucris subsparsis paniculatis, dentibus 5 valde inæqualibus cum bracteis parvulis aceroso-subulatis cuspide recurva superatis, unico (rarius duobus) majori seu foliaceo-ampliato tubo cylindrico pedicelliformi lævi nunc subæquilongo, cæteris subulatis parvis; tubo perigonii cylindrico; staminibus 9; embryone recto, cotyledonibus linearibus radicula longioribus. — Nevada, on the borders of the desert, Humboldt, Reese-River, and Grass valleys, Torrey, Stretch, C. Watson in Clarence King's Expedition. Leaves small. Involucre one and a half or at length two lines long, most of the five teeth about half a line long, but the enlarged foliiform one oval, oblong, or lanceolate: sometimes two or three of them are more or less accrescent. Flower on a slender pedicel. Seed linear-subulate. Cotyledons remarkably long and slender.

6. LASTARRIÆA, Remy.

Involucrum nullum. Flores cymoso-glomerati: perigonium coriaceo-herbaceum, 6-dentatum, involucrum *Chorizanthis* admodum simulans, dentibus subulatis cuspide recurva uncinata terminatis. Stamina 3, fauci perigonii inserta, lobis interioribus opposita, brevia, utrinque dente membranaceo seu filamento sterili comitata. Ovarium sessile. Achenium triquetrum. Embryo subarcuatus, cotyledonibus angustis, radicula longioribus. — Herbula annua multicaulis, foliis linearibus, floralibus bracteisve oblongis seu lanceolatis verticillatis cuspide recurva uncinata armatis tenacibus.

1. L. Chilensis, Remy in Gay, Fl. Chil. 5, p. 289, t. 58, f. 1; DC. Prodr. 14, p. 186. Chili, Bertero, Gillies. — California, J. Blake: station unknown; but probably introduced at some time from Chili, perhaps in the fleece of sheep and cattle, as the hooked cusps or short and stout awns of the bracts and calyx are tenacious, and the joints very fragile.

7. PTEROSTEGIA, Fischer & Meyer.

Involucrum monophyllum! tenue, primum florem sessilem fulcrans eodemque brevius, rotundatum, pl. m. bilobum, fructiferum valde ampliatum, scariosum, achenium laxe amplectens, vesiculosum, reticula-

tum, dorso bigibberoso-saccatum. Perigonium 6- (raro 5-)partitum, segmentis oblongo-lanceolatis æqualibus. Stamina segmentis perigonii numero æqualia, basi eorum inserta, quandoque pauciora. Achenium triquetrum. Embryo in albumine carnoso vel farinoso copioso excentricus, cotyledonibus orbiculatis radiculæ accumbentibus. — Herbæ annuæ Californicæ, caulibus tenuibus dichotomo-ramosissimis diffusis, foliis oppositis, inferioribus sæpe bilobis lobis nunc iterum 2–3-lobatis, superioribus quandoque pl. m. crenulato-denticulatis; involucris primum minimis terminalibus alaribusque subsessilibus; floribus flavidulis parvis.

The involucre has been, as we suppose, wrongly described as diphyllous. It is rightly said by Hooker (in Bot. Beechey) to be "two-lobed." These lobes may answer each to one of a pair of leaves, like the cauline, but united on one side, in a manner sometimes observed in the bracts of *Oxytheca;* but we are confident that the whole rather answers to a single bracteolar leaf, which is two-lobed after the fashion of the lower cauline leaves; and so is homologous (not with the involucre of *Eriogonum* but) with a bractlet in *Nemacaulis.** Bentham's view (in Bot. Sulph. & DC. Prodr. 14, p. 27), first, that there are a pair of these involucral leaves, and second, that each is composed of three leaves, the contiguous margins of which expand into the dorsal wings or crests, is most of all untenable. These crests are gibberosities, one for each lobe, sometimes shallow or inconspicuous, sometimes very deep and large, and crest-like or wing-like.

1. P. DRYMARIOIDES, Fischer & Meyer, Ind. Sem. Petrop. 2, p. 23, & Sert. Petrop. fasc. 3, tab. fol.; Hook. & Arn. Bot. Beech. t. 90. Tenella, pilosulo-pubescens; foliis inferioribus longe petiolatis flabelliformibus obcordato-bilobis seu emarginatis nunc bis bilobis, superioribus ramealibusque rotundatis obovatis spathulatisque haud raro crenulato-denticulatis; involucro fructifero (lin. 1 – 1½ longo) profundius bilobo margine dentato vel laciniato. *P. microphylla, diphylla,* & var. *biloba,* Nutt. Pl. Gamb. l. c. — Common in California along the coast: very variable.

2. P. MACROPTERA, Benth. Sulph. p. 44. Major, rigidior; ramis junioribus cano-pubescentibus; foliis (ramealibus) spathulatis integerrimis subcarnosis vix petiolatis; involucro fructifero (semipollicari) margine sinuato. — Bay of Magdalena, Lower California, Hinds.

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* Payer, who in his *Organogenie,* tab. 64, has well shown its development, we find, takes a similar view.

Six hundred and seventeenth Meeting.

February 8, 1870. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President called the attention of the Academy to the recent decease of Overbeck, at Rome, of the Foreign Honorary Members.

Dr. E. H. Clark made a communication on the results of an analysis of one thousand cases of disease in general practice, as to the curative action of drugs.

Dr. Bowditch made a communication, illustrated by a chart, on the apparent connection of cloudy days and mortality from consumption, for the period from 1811 to 1857, and in this vicinity.

Two papers by Mr. G. W. Hill were presented at the meeting of December 11, 1869.

The following problem seems to possess some interest, and I have not, in my reading, met with any discussion of it: —

To determine the elements of the orbit of a planet or satellite, which moves in a circle in the plane of the ecliptic, from three observations of its direction from the earth, made at equal intervals of time; the positions of the earth and the central body at these times being known, but the sum of the masses of the central body and the planet or satellite being unknown.

Or, geometrically stated, —

In a plane, given a point as centre and three straight lines, required to describe a circle, so that the arcs intercepted between the first and second, and the second and third, lines may be equal.

Let generally R denote the distance of the central body from the earth;
" " L its longitude as seen from the earth;
" " r the radius of the orbit of the planet;
" " λ its longitude as seen from the earth;
" " χ its longitude as seen from the central body.

Moreover, employ the subscripts $(_{-1})$, $(_0)$, $(_1)$, to denote the special values of the above quantities, which have place respectively at the three times of observation in their order.

If a perpendicular be let fall from the central body on the straight line which joins the earth and the body whose orbit is to be determined, its length is obviously

$$R \sin (\lambda - L);$$

another expression for the length of the same line is

$$r \sin (\chi - \lambda).$$

Hence for the three times of observation, the three equations

$$\begin{aligned} r \sin (\chi_{-1} - \lambda_{-1}) &= R_{-1} \sin (\lambda_{-1} - L_{-1}), \\ r \sin (\chi_0 - \lambda_0) &= R_0 \sin (\lambda_0 - L_0), \\ r \sin (\chi_1 - \lambda_1) &= R_1 \sin (\lambda_1 - L_1). \end{aligned}$$

But since the orbit is circular, χ increases uniformly with the time, and consequently $\chi_0 - \chi_{-1} = \chi_1 - \chi_0 = \eta$ suppose.

Thus the above equations may be written

$$\begin{aligned} r \sin (\chi_0 - \eta - \lambda_{-1}) &= R_{-1} \sin (\lambda_{-1} - L_{-1}) = a_{-1}, \\ r \sin (\chi_0 - \lambda_0) &= R_0 \sin (\lambda_0 - L_0) = a_0, \\ r \sin (\chi_0 + \eta - \lambda_1) &= R_1 \sin (\lambda_1 - L_1) = a_1, \end{aligned}$$

which serve to determine the three unknown quantities r, χ_0, and η; and it will be noticed that their right-hand members are known quantities.

If the sum of the masses of the central body and the body whose orbit is sought is denoted by μ, and the common interval of time between the observations by t,

$$\eta = t \sqrt{\frac{\mu}{r^3}};$$

thus, if μ were known, two observations would suffice to determine the orbit; but if μ is not known, η must be regarded as an independent unknown quantity. Hence the necessity for the restriction put at the end of the statement of the problem. Also by this restriction the problem is made to depend on the solution of an algebraical equation instead of a transcendental one.

The equations can be simplified by taking two unknown quantities, ω and σ, instead of χ_0 and η, such that

$$\omega = \chi_0 - \frac{\lambda_1 + \lambda_{-1}}{2}$$

$$\sigma = \eta - \frac{\lambda_1 - \lambda_{-1}}{2}$$

and putting

$$\delta = \frac{\lambda_1 + \lambda_{-1}}{2} - \lambda_0.$$

Then the equations become

$$r \sin(\omega - \sigma) = a_{-1},$$
$$r \sin(\omega + \delta) = a_0,$$
$$r \sin(\omega + \sigma) = a_1.$$

Or,

$$r \sin \omega \cos \sigma = \frac{a_1 + a_{-1}}{2}.$$
$$r \sin(\omega + \delta) = a_0,$$
$$r \cos \omega \sin \sigma = \frac{a_1 - a_{-1}}{2}.$$

If $r \sin \omega$ and $r \cos \omega$ are eliminated from these equations, and we make

$$\frac{a_1 + a_{-1}}{2\,a_0} \cos \delta = \mathrm{a} = c \cos \beta,$$

$$\frac{a_1 - a_{-1}}{2\,a_0} \sin \delta = \mathrm{b} = c \sin \beta,$$

where c may be taken as positive and the quadrant of β becomes determinate, or β may be assumed between the limits ± 90°, there will be obtained, for the determination of σ, the equation

$$\sin 2\,\sigma = 2\,c \sin(\sigma + \beta).$$

The computation of c and β may be facilitated by introducing the auxiliary quantities k and ζ, such that

$$k \sin \zeta = \frac{a_{-1}}{\sqrt{2}\,a_0}$$

$$k \cos \zeta = \frac{a_1}{\sqrt{2}\,a_0},$$

then

$$c \cos \beta = k \cos(45° - \zeta) \cos \delta.$$
$$c \sin \beta = k \sin(45° - \zeta) \sin \delta.$$

It is evident that the determination of σ depends on the solution of an equation of the fourth degree; but its value can be very readily obtained from the above equation by the tentative process; and then r and ω by means of the equations

$$r \sin \omega = \frac{a_0\,k \cos(45° - \zeta)}{\cos \sigma},$$

$$r \cos \omega = \frac{a_0\,k \sin(45° - \zeta)}{\sin \sigma},$$

and finally χ_0 and η by means of the relations given above.

There is a very simple geometrical construction of the roots of the equation in σ. Making $\cos\sigma = \chi$, and $\sin\sigma = y$, the values of χ and y are the co-ordinates of the intersections of the curves whose equations are

$$\chi^2 + y^2 = 1,$$
$$(\chi - a)\ (y - b) = a\,b$$

Consequently, if we construct the equilateral hyperbola whose equation is

$$\chi y = \pm 1,$$

and from a point on it, whose co-ordinates are

$$\chi^1 = -\frac{a}{\sqrt{\pm a\,b}},$$

$$y^1 = -\frac{b}{\sqrt{\pm a\,b}},$$

as centre, we describe a circle, whose radius is $\frac{1}{\sqrt{\pm a\,b}}$, and then draw radii to the points of intersection of the curves, the angles made by these radii with the χ axis of co-ordinates are the values of σ. Since the centre of the circle is on the hyperbola, there are at least two intersections, and thus the equation in σ has at least two real roots. The geometrical construction readily affords the condition which a and b must satisfy in order that there may be four real roots. The condition is, that the length of the straight line drawn from the point a, b, on the hyperbola whose equation is

$$\chi\, y = a\,b$$

normal to the opposite branch, shall be less than unity. The equation to the normal which passes through the point χ'', y'' on this curve, is

$$\chi''\,(\chi - \chi'') - y''\,(y - y'') = 0.$$

The condition that it passes through the point a, b, gives

$$\chi''\,(\chi'' - a) - y''\,(y'' - b) = 0,$$
$$\chi''\,y'' = a\,b.$$

If we multiply the first of these by χ''^2, we get

$$\chi''^3\,(\chi'' - a) - a\,b\,(a\,b - b\,\chi'') = 0,$$

or, rejecting the useless factor $\chi'' - \mathrm{a}$,

$$\chi''^3 + \mathrm{a}\,\mathrm{b}^2 = 0,$$

whence

$$\chi'' = -\sqrt[3]{\mathrm{a}\,\mathrm{b}^2},$$

and by interchanging a and b,

$$y'' = -\sqrt[3]{\mathrm{a}^2\,\mathrm{b}}.$$

And thus the length of the normal

$$\sqrt{(\chi''-\mathrm{a})^2 + (y''-\mathrm{b})^2} = \left[(\mathrm{a} + \sqrt[3]{\mathrm{a}\,\mathrm{b}^2})^2 + (\mathrm{b} + \sqrt[3]{\mathrm{a}^2\,\mathrm{b}})^2\right]^{\frac{1}{2}}$$
$$= [\mathrm{a}^{\frac{2}{3}} + \mathrm{b}^{\frac{2}{3}}]^{\frac{3}{2}}.$$

Consequently,

if $\mathrm{a}^{\frac{2}{3}} + \mathrm{b}^{\frac{2}{3}} < 1$, there will be four real roots;
" $\mathrm{a}^{\frac{2}{3}} + \mathrm{b}^{\frac{2}{3}} = 1$, there will be four, and two will be equal;
" $\mathrm{a}^{\frac{2}{3}} + \mathrm{b}^{\frac{2}{3}} > 1$, there will be only two real roots.

We will now show how to arrive at a direct solution of the problem by the employment of trigonometric formulæ. If $\tan\sigma$ is taken for the unknown quantity, the equation, on which the solution of the problem depends, is

$$[c\cos\beta\tan\sigma + c\sin\beta]^2\,(1+\tan^2\sigma) = \tan^2\sigma,$$

or if we put $\tan\sigma = \chi$,

$$(\chi + \tan\beta)^2\,(\chi^2+1) = \frac{\chi^2}{c^2\cos^2\beta},$$

or, expanded,

$$\chi^4 + 2\tan\beta\,.\,\chi^3 + \frac{c^2-1}{c^2\cos^2\beta}\,\chi^2 + 2\tan\beta\,.\,\chi + \tan^2\beta = 0.$$

A quantity μ may be assumed, such that this biquadratic shall be resolved into the two quadratics

$$\chi^2 + 2\,\frac{\sin\mu\cos(\beta+\mu)}{\cos\beta\cos2\mu}\,\chi + \tan\beta\tan\mu = 0,$$

$$\chi^2 + 2\,\frac{\cos\mu\sin(\beta-\mu)}{\cos\beta\cos2\mu}\,\chi + \tan\beta\cot\mu = 0.$$

That this is possible will be evident on multiplying the left-hand members of these equations together, for after some reductions easy to make, all the coefficients, with the exception of that of χ^2, will be found to be identical with those of the biquadratic; and consequently μ is determined by the equation

$$\tan\beta\,[\tan\mu+\cot\mu]+2\,\frac{\sin 2\mu\,\sin(\beta-\mu)\,\cos(\beta+\mu)}{\cos^2\beta\,\cos^2 2\mu}=\frac{c^2-1}{c^2\cos^2\beta},$$

or

$$\frac{c^2\sin 2\beta}{\sin 2\mu}-\frac{c^2\sin 2\mu\,[\sin 2\mu-\sin 2\beta]}{1-\sin^2 2\mu}=c^2-1,$$

or

$$\sin^3 2\mu+(c^2-1)\sin 2\mu-c^2\sin 2\beta=0.$$

That this cubic will always give at least one real value for μ, is evident on making in the left-hand member $\sin 2\mu$ successively equal to -1, 0, and $+1$; the results obtained are

$-c^2(1+\sin 2\beta)$, always negative;
$-c^2\sin 2\beta$, negative or positive, according to the sign of $\sin 2\beta$;
$+c^2(1-\sin 2\beta)$, always positive.

Moreover, it is plain that there is one real value of μ, which makes $\sin 2\mu$ and $\sin 2\beta$ have like signs; this value we shall adopt.

Making, according as c^2 is greater or less than unity,

$$c^2=\sec^2.\,\gamma,\text{ or }c^2=\cos^2\gamma',$$

the above cubic is solved by these formulæ (see Chauveuet's Trigonometry, p. 96), it being necessary to make three different cases.

Case I.

$$\tan\phi=\frac{2\sin^2\gamma\,\tan\gamma}{\sqrt{27}\,\sin 2\beta},$$

$$\tan\psi=\tan^{\frac{1}{3}}\frac{\phi}{2},$$

$$\sin 2\mu=\frac{2}{\sqrt{3}}\tan\gamma\,\cot 2\psi.$$

Case II.

$$\sin\phi=\frac{2\sin\gamma'\,\tan^2\gamma'}{\sqrt{27}\,\sin 2\beta},$$

$$\tan\psi=\tan^{\frac{1}{3}}\frac{\phi}{2},$$

$$\sin 2\mu=\frac{2}{\sqrt{3}}\sin\gamma'\,\operatorname{cosec} 2\psi.$$

Case III.

$$\sin 3\,\phi = \frac{\sqrt{27}\,\sin 2\,\beta}{2\,\sin \gamma'\,\tan^2 \gamma'},$$

$$\sin 2\,\mu = \frac{2}{\sqrt{3}}\,\sin \gamma'\,\sin\,(\phi \pm 60^\circ).$$

When ϕ is impossible in Case II., the formulæ of Case III. must be used; and the upper or lower member of the double sign in the second equation must be taken according as $\sin 2\,\beta$ is positive or negative; in order that $\sin 2\,\mu$ may have the same sign with $\sin 2\,\beta$. All the auxiliary angles ϕ, ψ, and μ may be taken between the limits $\pm\,90^\circ$. Since $\sin 2\,\beta\,\sin 2\,\mu$ is always positive, $\tan \beta\,\tan \mu$ and $\tan \beta\,\cot \mu$ are so likewise, since they are respectively equivalent to

$$\frac{\sin 2\,\beta\,\sin 2\,\mu}{4\,\cos^2 \beta\,\cos^2 \mu} \text{ and } \frac{\sin 2\,\beta\,\sin 2\,\mu}{4\,\cos^2 \beta\,\sin^2 \mu}.$$

Let us take two auxiliary angles θ and θ', determined by the equations

$$\sin 2\,\theta = -\frac{\tan^{\frac{1}{2}} \beta\,\tan^{\frac{1}{2}} \mu\,\cos \beta\,\cos 2\,\mu}{\sin \mu\,\cos\,(\beta + \mu)},$$

$$\sin 2\,\theta' = -\frac{\tan^{\frac{1}{2}} \beta\,\cot^{\frac{1}{2}} \mu\,\cos \beta\,\cos 2\,\mu}{\cos \mu\,\sin\,(\beta - \mu)},$$

or by the equations

$$\sin 2\,\theta = \mp\,\frac{\cos 2\,\mu}{\cos\,(\beta + \mu)}\,\sqrt{\frac{\sin 2\,\beta}{\sin 2\,\mu}},$$

$$\sin 2\,\theta' = \mp\,\frac{\cos 2\,\mu}{\sin\,(\beta - \mu)}\,\sqrt{\frac{\sin 2\,\beta}{\sin 2\,\mu}},$$

where the upper or lower of the signs must be taken according as $\frac{\cos \beta}{\sin \mu}$ in the first and $\frac{\cos \beta}{\cos \mu}$ in the second are positive or negative; and $2\,\theta$ and $2\,\theta'$ may also be taken within the limits $\pm\,90^\circ$. The four values of χ or $\tan \sigma$ are then

$$\tan \sigma = \tan^{\frac{1}{2}} \beta\,\tan^{\frac{1}{2}} \mu\,\tan \theta,$$
$$\tan \sigma = \tan^{\frac{1}{2}} \beta\,\tan^{\frac{1}{2}} \mu\,\cot \theta,$$
$$\tan \sigma = \tan^{\frac{1}{2}} \beta\,\cot^{\frac{1}{2}} \mu\,\tan \theta',$$
$$\tan \sigma = \tan^{\frac{1}{2}} \beta\,\cot^{\frac{1}{2}} \mu\,\cot \theta'.$$

If the value of $\sin 2\,\theta$ or of $\sin 2\,\theta'$ does not fall within the limits

$\pm$ 1, it indicates that the two corresponding values of tan σ are imaginary. The ambiguity in the determination of σ from its tangent is to be removed by taking it in that quadrant which permits the equation

$$\sin 2\,\sigma = 2\,c \sin(\sigma + \beta)$$

to be satisfied.

Although all these roots will satisfy the equations with which we began this discussion, yet they do not all necessarily belong to the problem. The reason of this is, that the three equations are not a complete statement of all the conditions of the problem. If we denote by Δ the distance of the body, whose orbit we are determining, from the earth, we shall have

$$\begin{aligned}
\Delta_{-1} &= r \cos(\chi_0 - \eta - \lambda_{-1}) + R_{-1} \cos(\lambda_{-1} - L_{-1}),\\
\Delta_0 &= r \cos(\chi_0 - \lambda_0) \qquad\quad\; + R_0 \cos(\lambda_0 - L_0),\\
\Delta_1 &= r \cos(\chi_0 + \eta - \lambda_1) \quad + R_1 \cos(\lambda_1 - L_1).
\end{aligned}$$

The conditions of the problem demand that Δ_{-1}, Δ_0 and Δ_1 shall be essentially positive. Hence, if any system of values of r, χ_0 and η renders any of these quantities negative, it must be rejected. These rejected solutions really belong to the problem when one or more of the quantities λ_{-1}, λ_0 and λ_1 are increased by 180°. In fact, on referring to the equations with which we started, we see they are not altered when any one of the quantities λ is increased by 180°. The geometrical statement of the problem is more comprehensive than the application of it to the discovery of the elements of circular orbits. Instead of the above criteria for the rejection of solutions not applicable, the following, which is simpler, may be used, viz. that χ always must lie in the angle between $L + 180°$ and λ which is less than 180°.

This example is added for the sake of illustration: —

Suppose in the case of Venus revolving about the sun we have these data,

Wash. Mean Time.	λ	L	log R
1869 Jan. 1.0	250° 22′ 59″.1	281° 24′ 54″.9	9.9926528
" June 15.0	94 37 54. 9	84 33 34. 1	0.0069342
" Nov. 27.0	292 3 21. 2	245 32 49. 3	9.9939666

There will be found

$\log a_{-1} = 9.7048977_n$, $\log a_0 = 9.2497072$, $\log a_1 = 9.8545925$,
$\log k = 0.5426896$, $\zeta = 324° \, 41' \, 4.''52$, $\delta = 176° \, 35' \, 15.''25$,
$\log \mathrm{a} = 9.7678074_n$, $\log \mathrm{b} = 9.3111404$.

Constructing the equilateral hyperbola whose equation is $xy = -1$, and the circle whose radius is 2.89, and the co-ordinates of its centre $x' = +1.69$, $y' = -0.59$, we find the two roots of the equation in σ, $\sigma = 7\frac{1}{2}°$, $\sigma = 241\frac{1}{2}°$. In fact, the value of $a^{\frac{2}{3}} + b^{\frac{2}{3}} = 1.0475$ shows that the equation has, in this case, but two real roots. Pursuing the calculation,

$$\log c = 9.7928205, \quad \beta = 160° \, 44' \, 24''.60, \quad \gamma' = 51° \, 38' \, 20''.85.$$

Case II. is to be used here.

$\phi = -50° \, 40' \, 40''.00$, $\psi = -37° \, 56' \, 3''.23$, $\mu = -34° \, 30' \, 27''.50$ $\theta = 14° \, 49' \, 46''.36$, θ' is impossible, which confirms the preceding statement about the number of real roots; and the values of σ are

$$\sigma = 7° \, 23' \, 36''.95 \text{ and } \sigma = 241° \, 37' \, 18''.04.$$

If we employ the tentative process with the equation

$$\sin 2\sigma = 2c \sin (\sigma + \beta),$$

we shall get $\sigma = 7° \, 23' \, 36''.97$ and $\sigma = 241° \, 37' \, 17''.95$; as these values are more accurate, we shall use them. The two solutions are

$$\begin{array}{rlcrl}
\omega = & 1° \, 16' \, 6''.99, & \qquad & \omega = & 197° \, 31' \, 54''.15, \\
\log r = & 0.6767422, & & \log r = & 9.8624217, \\
\chi_0 = & 272° \, 29' \, 17''.14, & & \chi_0 = & 108° \, 45' \, 4''.30, \\
\eta = & 28 \;\; 13 \;\; 48 \,.02, & & \eta = & 262 \;\; 27 \;\; 29 \,.00.
\end{array}$$

On applying the above-mentioned criteria, the first solution is seen to be inadmissible, it makes Δ_0 and Δ_1 negative. If both λ_0 and λ_1 are increased by 180°, the solution will apply. The given example has then but one solution. Below we give a comparison between the values of the elements of Venus's orbit as found in this example, and those of the "Tables"; the differences are of course to be attributed to the neglect of the eccentricity and inclination of the orbit, and in a smaller degree to aberration and perturbations.

	From the Example.	From the Tables.
Mean Distance from the sun	0.7284868	0.7233323
Mean Longitude Jan. 1.0 1869	206° 17′ 35″.30	204° 57′ 28″.89
Mean Motion in Julian Year	2091552″.2	2106641″.438

New Method for facilitating the Conversion of Longitudes and Latitudes of Heavenly Bodies, near the Ecliptic, into Right Ascensions and Declinations, and vice versa.

In the computation of a Lunar Ephemeris, the conversion of the longitudes and latitudes into right ascensions and declinations forms no inconsiderable part of the work to be done. Prof. Hansen, at the end of his "Tables de la Lune," has given some tables, with the view of diminishing the amount of labor required in this conversion.

But their employment seems to me to possess little, if any, advantage over the use of the ordinary formulæ of spherical trigonometry. I propose the following method, which perhaps in a slight degree is more ready than that of Prof. Hansen.

Designating the right ascension, declination, longitude, latitude, and the obliquity of the ecliptic respectively by α, δ, l, b and ϵ, we have the following equations

$$\sin\delta = \cos\epsilon\sin b + \sin\epsilon\cos b\sin l$$

$$= \cos\epsilon\sin b + \frac{\sin\epsilon}{2}\sin(l+b) + \frac{\sin\epsilon}{2}\sin(l-b),$$

$$\tan\frac{\alpha + 6^{\mathrm{h}}}{2} = \frac{\cos\frac{\epsilon+b+\delta}{2}}{\cos\frac{\epsilon-(b+\delta)}{2}}\tan\frac{l+90^\circ}{2}.$$

The first equation is well known, the second is easily derived from the known formula, expressed in the usual notation,

$$\tan\frac{A}{2}\tan\frac{B}{2} = \frac{\sin(s-c)}{\sin s},$$

when we remember that, in considering the triangle, formed by the heavenly body and the poles of the equator and ecliptic, A, B, s and c are replaced by $90^\circ + \alpha$, $90^\circ - l$, $90^\circ + \frac{\epsilon-(b+\delta)}{2}$ and ϵ.

Suppose we were to tabulate the functions $\cos\epsilon\sin A$ and $\frac{\sin\epsilon}{2}\sin A$ for a certain value of ϵ (as $23^\circ\ 27'\ 20''$ which is nearly its value at present), and in small side tables put the variations of these functions for increments of $1''$, $2''$. .. .. $9''$ in ϵ; we should have the value of $\sin\delta$ by entering the first table with the argument $A = b$, and the second successively with the arguments $A = l + b$ and $A = l - b$, and adding the results thus obtained, after having corrected them for the deviation of the value of ϵ from that adopted in the tables. After which the value of δ could be obtained from a table of natural sines. For the case of the moon, the first function would need tabulation only between the limits $A = 0°$ and $A = 5° \, 17'$; it might be tabulated for every $10''$. The second would have to be tabulated from 0° to 90°; it might be given for every minute of arc. The numbers in these tables might be rendered always positive by adding a constant to them; as, for instance, 0.1 to the first function, and 0.2 to the second; and thus the addition of the three terms of sin δ be made easier.

We should then have to subtract 0.5 from the sum, in order to get sin δ; or we might prepare a special table, which, with the argument $0.5 + \sin \delta$, should give δ. But by the addition of these constants, the extent of the tables would be doubled, as it would be necessary to tabulate the numbers which correspond to negative values of the arguments.

The factor by which $\tan \frac{l + 90°}{2}$ must be multiplied to obtain $\tan \frac{a + 6^h}{2}$ is always positive, and, ϵ being regarded as constant, is a function of $b + \delta$, and, for negative values of $b + \delta$, its value is the reciprocal of that which corresponds to positive values of $b + \delta$. Moreover, when $b + \delta$ is a tolerably small angle, it does not differ much from unity, and varies very uniformly. In the case of the moon $b + \delta$ rarely exceeds the limits ± 34°, and the common logarithm of this quantity lies between 9.9447979 and 0.0552021; and its rate of change per minute of arc in $b + \delta$ varies only from 262 to 289 units of the seventh decimal place. We may, with the better advantage, tabulate the function

$$\log \cos \frac{\epsilon - A}{2} - \log \cos \frac{\epsilon + A}{2},$$

for every minute of arc of the argument A from 0° to 34°, with the precept that it is to be subtracted from $\log \tan \frac{l + 90°}{2}$ when $b + \delta$ is a positive angle, but added when $b + \delta$ is negative. It will be necessary to append to the table the variation of the function for a change in ϵ. The functions $\log \tan (45° + \frac{l}{2})$ and $\log \tan (45° + \frac{a}{2})$ can be found from the logarithmic tables, but some labor would be spared had we tables which gave $\log \tan (45° + \frac{A}{2})$ with the argument A both in arc and time; which tables would be useful in many other cases, since this function is frequently met with in trigonometric formulæ.

The modifications necessary in applying this method to the inverse problem of determining the longitude and latitude from the right ascension and declination are obvious. The variations due to the change of the obliquity might perhaps be neglected in using the tables, especially in the case of the declination, and computed at the end by means of the very simple formulæ

$$\frac{d\alpha}{d\epsilon} = -\tan\delta\cos\alpha,$$

$$\frac{d\delta}{d\epsilon} = \sin\alpha.$$

Take this example for illustration: —

On January 14.0, 1871, G. M. T. we have in the case of the moon,

$l = 206° 40' 35.''9$	$\epsilon = 23° 27' 19.''81$	
$b = +5 \quad 3 \quad 16.0$	From Tab. I., Arg. b,	$+0.0808224$
	$-1.7 \times (\Delta\epsilon = -0.19)$	0
$l + b = 211 \quad 43 \quad 51.9$	From Tab. II., Arg. $l + b$,	-0.1046706
	$-11.7 \times \Delta\epsilon$	$+2$
$l - b = 201 \quad 37 \quad 19.9$	From Tab. II., Arg. $l - b$,	-0.0733354
	$-8.2 \times \Delta\epsilon$	$+2$
$\delta = -5 \quad 34 \quad 37.16$	$\sin\delta$	-0.0971832
$b + \delta = -0 \quad 31 \quad 21.16$	$\log\tan 148° 20' 17.''95$	9.7900662_n
$\alpha = 13^h 46^m 19^s.12$	From Tab. III., to be added,	0.0008223
	$+0.09 \times \Delta\epsilon$	0
	$\log\tan 9^h 53^m 9^s.56$	9.7908885_n

The objection to this method is, that so many arguments $l + b$, $l - b$, $b + \delta$, $45° + \frac{l}{2}$, and α from $45° + \frac{\alpha}{2}$ are to be formed; but this is confessedly less fatiguing than the taking of tabular quantities from a table.

It may be allowed to notice here a series, which determines α in terms of l, viz.: —

$$\begin{aligned} \alpha = l &+ \frac{2}{1}\tan\frac{\epsilon}{2}\tan\frac{b+\delta}{2}\cos l \\ &- \frac{2}{2}\tan^2\frac{\epsilon}{2}\tan^2\frac{b+\delta}{2}\sin 2l \\ &- \frac{2}{3}\tan^3\frac{\epsilon}{2}\tan^3\frac{b+\delta}{2}\cos 3l \end{aligned}$$

$$+ \frac{2}{4} \tan^4 \frac{\epsilon}{2} \tan^4 \frac{b + \delta}{2} \sin 4\, l$$

$$+ \&c. \ldots.$$

As $\tan \frac{\epsilon}{2} \tan \frac{b + \delta}{2}$, in the case of the moon, is always between the limits $\pm \frac{2}{31}$, the above series is, for this body, quite convergent.

I add the values of the function $\log \frac{\cos \frac{\epsilon - A}{2}}{\cos \frac{\epsilon + A}{2}}$, computed for every degree from 0° to 35° of the argument A and for $\epsilon = 23° \; 27' \; 20''$.

A	$\log \frac{\cos \frac{\epsilon - A}{2}}{\cos \frac{\epsilon + A}{2}}$	Δ	Δ²	Change of this function for an inc. in ε of 1″ in units of the seventh decimal.
0°	.0000000			+ 0.00
1	.0015736	+ 15736	+ 2	0.19
2	.0031474	15738	6	0.38
3	.0047218	15744	7	0.57
4	.0062969	15751	10	0.77
5	.0078730	15761	12	0.96
6	.0094503	15773	16	1.15
7	.0110292	15789	17	1.34
8	.0126098	15806	20	1.54
9	.0141924	15826	23	1.73
10	.0157773	15849	25	1.92
11	.0173647	15874	28	2.12
12	.0189549	15902	31	2.31
13	.0205482	15933	32	2.50
14	.0221447	15965	37	2.70
15	.0237449	16002	38	2.89
16	.0253489	16040	41	3.09
17	.0269570	16081	43	3.28
18	.0285694	16124	48	3.48
19	.0301866	16172	49	3.68
20	.0318087	16221	52	3.88
21	.0334360	16273	55	4.08
22	.0350688	16328	58	4.28
23	.0367074	16386	61	4.48
24	.0383521	16447	64	4.68
25	.0400032	16511	67	4.88
26	.0416610	16578	70	5.08
27	.0433258	16648	73	5.29
28	.0449979	16721	76	5.49
29	.0466776	16797	80	5.70
30	.0483653	16877	82	5.90
31	.0500612	16959	87	6.11
32	.0517658	17046	89	6.32
33	.0534793	17135	93	6.53
34	.0552021	17228	+ 97	6.74
35	0.0569346	+ 17325		+ 6.95

Six hundred and eighteenth Meeting.

March 8, 1870. — ADJOURNED STATUTE MEETING.

The PRESIDENT in the chair.

The President called the attention of the Academy to the recent decease of Dr. Theodore Strong, of New Brunswick, N. J., of the Associate Fellows.

The President communicated a report from the Council, nominating candidates for Associate and Foreign Honorary membership, and also read nominations of candidates for Resident Fellowship.

A committee was appointed to confer with other learned societies to secure a building for their accommodation with the Academy. The Vice-President, and Messrs. Nathaniel Thayer, William Gray, J. I. Bowditch, and C. W. Eliot, were appointed on this committee.

Six hundred and nineteenth Meeting.

April 12, 1870. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President called the attention of the Academy to the recent decease of Rev. Dr. Frothingham, of the Resident Fellows.

Mr. C. F. Adams communicated two papers by W. B. Burden, of England, which were referred to Mr. Francis and Mr. Batchelder as a committee to examine them.

Six hundred and twentieth Meeting.

May 10, 1870. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters relative to exchanges.

Dr. Clark made a communication on the medical and physiological action of the chloral hydrate.

Professor Lovering made the following communication: —

"Optical Meteorology has been developed mathematically with greater success than any other department of this complex science. The principal features of a fully developed halo are: 1. The inner circle, concentric with the luminary, and having a radius of about 22°. 2. The outer circle, also concentric with the luminary, and having a radius of about 46°. Both of these circles, called the smaller and larger halos, are tinged with the colors of the spectrum, the blue being the outermost color. 3. The parhelion circle which passes through the luminary and is parallel to the horizon. This circle is white. 4. Upon this circle, and at a distance of 22° or more from the luminary, are two mock suns, the edges towards the sun being reddish and the opposite edges bluish. 5. A sort of tail stretching from these mock suns horizontally, and opposite to the line which connects them with the sun, to the distance of 43° 28′, or more, from the sun. 6. The tangent curve to the inner halo. 7. The tangent curve to the outer halo.

All these features of the halo are satisfactorily explained by refraction and reflection, produced by hexagonal prisms of ice, floating or sinking in the higher region of the atmosphere. These particles may be so situated as to present three independent cases. 1. They may be indiscriminately in all possible positions. 2. The axes of the prisms may be parallel and vertical, the sides of the prisms facing all azimuths. 3. The axes of the prisms may be horizontal, but in all possible azimuths. The *first* case would exist when the particles of ice were newly formed, and had not accumulated so much velocity that the resistance of the air would bring the surface of least resistance to the front. If the three dimensions of the crystal were nearly the same, there would be no surface of least resistance, and the air would exercise no directing influence. The *second* case would arise, as the consequence of increasing velocity and resistance, if the *minimum* section of the prism was parallel to the base. The *third* case would arise, under similar circumstances, if the minimum section was perpendicular to the base. All three cases might coexist at the same moment, because some of the prisms were long and others short, and because some of the prisms had had less time than others to fall, and accumulate velocity and resistance, since their first formation.

Of the various angles formed by the sides and ends of these prisms, some would exceed the limit of transmission, others would be zero and produce no refraction. There would remain, of the available angles, those of 60° made by alternate faces, and those of 90° made by the faces and ends of the prisms. The inner halo is caused by refraction through an angle of 60°, the refracting edges being parallel to the tangents to different parts of the halo. The outer halo is caused by refraction through an angle of 90°, the refracting edges of different prisms being parallel to different tangents. Both halos require that the prisms should be scattered at random, so that a sufficient number would be found in the required positions. The white parhelion circle is produced by reflection from the sides of the prisms when their axes are vertical. These same prisms, acting through the angle of 60°, would produce the mock *suns* whenever they stood in the position of minimum deviation; while others, not in the position of minimum deviation, would produce the colored appendages to the mock suns. These same prisms, acting through the angle of 90°, would cause the tangent curve to the larger halo of 46°. If the luminary were above the horizon, reflection from the upper end of these prisms would produce an uncolored image of the luminary underneath the real luminary; but this image would not be visible unless the observer were elevated to a great height above the surface of the earth. If the luminary were a little below the horizon, reflection from the lower end of these prisms would produce a similar image above the luminary, and above the horizon, which would be visible; and hence the luminary might appear to have risen again after setting. When the axes of the prisms are horizontal, refraction by the angle of 60° would cause the tangent curve to the inner halo of 22°. If large numbers of prisms were floating contemporaneously in all three positions, all these phenomena might coexist; otherwise, only a portion of these various features would be displayed. It is evident, therefore, that both halos might be wanting, and yet one or both of the curves which are tangent to them might appear. If the tangent curve to the larger halo of 46° is seen, generally the mock *suns* and the *parhelion* circle are also seen, even in the absence of the halo itself. In other words, all which vertical prisms are capable of producing would generally, though not necessarily, be seen at the same time.

These general features are somewhat changed by the altitude of the sun, or other luminary, above the horizon. When the sun is in the horizon, the parhelia are at the same distance from it as the inner halo, and rest upon it. As the sun rises they go outside of the halo, and become impossible when the altitude of the sun exceeds 60° 45′. The lengths of the tails affixed to the mock suns increase as the sun rises, until the limiting angle of transmission is reached. There is an inferior as well as a superior tangent arc to the halo of 22°. Their figures are complex, and they join in a single curve, circumscribing the halo itself, when the altitude of the sun exceeds 29° 15′. The inferior arc is rarely visible, unless the sun is more than 22° high. The halo of 46° is less bright than that of 22°, because it is larger and broader; and more light is reflected by the prisms under the larger incidences. The tangent curve to this halo is a circular arc having the zenith for its centre. It cannot be formed if the sun's altitude exceed 32° 12′. The semi-amplitude increases from 57° 48′ to 90°. But when it is 90°, its height is also 90° and its radius is reduced to zero. The maximum brightness is in the middle of the whole arc. This arc actually touches the halo of 46° only when the altitude of the sun is 22° 8′. It sensibly touches between the altitudes of 15° and 28°. If the sun were in the horizon, the tangent arc would be 12° 4′ above the summit of the halo. If the sun were 30° high, the tangent arc would be 3° 39′ above the halo. The altitude of 22° 8′ is most favorable, because, in this case, the middle of the arc is formed by rays which have suffered a *minimum* deviation. A tangent arc to the lowermost point of this halo is not impossible, but rare. In this event, the light must enter a vertical face and emerge at the base. The limits of altitude are complementary to those which the superior tangent requires; that is, the sun's altitude must be between 57° 48′ and 90°, the arc actually touching the halo at the special altitude of 67° 52′. If the axes of the prisms are shifted from a vertical to a horizontal position, the inferior and superior tangent arcs are changed to what are called *infra-lateral* and *supra-lateral.*

I have taken renewed interest in this theory of halos, which has been admirably developed by Bravais,* on account of the halo seen at Cambridge, January 6, 1870. This halo was seen about two o'clock, when the altitude of the sun was not far from 25°. The principal feature of the phenomenon, on that occasion, was the tangent curve to the halo of 46°, though the halo itself was not visible. At Waltham, the mock suns were seen, but not the tangent curve. The tangent curve seemed to be a *complete* circle, and the colors were very vivid, the red being the outermost color, or nearest to the sun. I have stated that, theoretically, the *maximum* amplitude of this curve is 180°, and, if the sun had an altitude of 25°, the amplitude would be only about 138°. The history of halos furnishes but few examples of this extraordinary occurrence, — a complete circumzenithal circle. On the 24th of January, 1838, Lambert* saw at Wetzler a circle, nearly complete, centred about the zenith, with vivid prismatic colors. On the 11th of July, 1749, Anderon† witnessed at Norwich, about five o'clock, P. M., when the sun was nearly 25° high, a *white* circle around the zenith. Bravais resorts to two expedients for explaining the enlargement of the circumzenithal arc into a complete circle, in a few rare cases. In the first place, the light may strike the vertical side of the prism too obliquely to be transmitted, so that, after being once or twice reflected upon other vertical sides, it may emerge from sides opposite to the usual ones. In the second place, each point of the arc, originally produced, causes a parhelion *circle*, all of which are superimposed upon the arc itself, as far as it extends. This last operation, however, would produce light without any discoloration. In the halo seen at Cambridge, the centre of the circle was decidedly south of the zenith. This fact requires us to suppose that the parallel axes of the prisms were not exactly vertical. A current in the atmosphere might change the direction of the descending particles of ice, but could the lateral motion, *with* the air, and not *in* it, develop any new resistance which would direct their axes away from the zenith?

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* Journ. de l'École Polytechnique. Cahier 31. Tome xviii.

I will now exhibit an experiment with an equilateral triangular prism of glass, and also a hollow one filled with water. The axis is vertical, about which it is made to revolve rapidly by clock-work. With a single prism and sunlight, or any bright and circular artificial light, all those features of the halo may be artificially produced which have been referred to the action of many prisms of ice, with vertical axes: the single prism, in its motion, assuming, in rapid succession, all the possible positions of these many prisms in the atmosphere. The halos themselves can be produced artificially, either by a conical prism, or by artificial crystals formed upon a plate of glass, as shown by Brewster‡ and others.§

The sun and moon are sometimes encircled by what are called coronæ. A corona may be distinguished from a halo in many ways. 1. It is much smaller even than the smallest of the two halos. 2. It is not rigidly bound to almost invariable dimensions, as the halo is. 3. When it is bright enough for the colors to be distinguished, the red is outside and the blue inside. 4. This arrangement of the colors, as well as the dimension of the circle, indicate that a corona is not produced by refraction or reflection in crystals of ice, but by interference. The following experiments which I shall now exhibit to the members of the Academy, will illustrate this subject. When light is sent through the intervals between straight and parallel lines, which have been nicely ruled upon glass, a series of colored fringes, parallel to the lines, results from the interference between rays which pass through different openings. If the glass were ruled with concentric circular lines, close together, these colored bands would become circular, and surround the source of light. By a rapid rotation of the ruled lines in their own plane, subjective rings result from the parallel fringes. In order to produce the required rotation without a material axis, which would intercept the rays of light from the eye of the observer, a platform is turned rapidly by clock-work. The border of this platform is covered with cloth. The circular frame in which the graduated glass is set rests upon this cloth, with its plane at right angles to the platform, and is rotated by friction. Friction-rollers at the sides and top hold it in its place, in the absence of any material axis of rotation. If concentric black circles are accurately drawn upon paper, and then photographed upon glass, on a greatly reduced scale, the photographed plate might be substituted for that on which circular lines had been scratched. Again, if a plate of glass is covered with india-ink, and then concentric circles are scratched upon the black surface, leaving the intermediate black rings, the same optical experiment can be performed. All three of these methods have been tried, but the finest and neatest circles were obtained by the last method; and the experimental result is very beautiful, especially if the ruled glass is placed immediately in front of the object-glass of an opera-glass.

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* Pogg. Ann. Physik und Chemie, xlvi. p. 660.

† Phil. Trans. xlvi. p. 203.

‡ A Treatise on Optics. Amer. edit. 1835, pp. 232, 233.

§ Amer. Journ. xvi. 398.

Although artificial coronæ of great beauty can be produced in these ways, it is obvious that the coronæ of nature must have a much simpler origin. And theory shows, that if lycopodium powder, the particles of which are small and spherical, and of uniform size, is sprinkled upon glass, a luminous spot, seen through the glass, will be surrounded with several coronæ, which, if less bright than those produced by the concentric rulings, on that very account have a greater resemblance to those known in Meteorology. It appears that, in this indiscriminate sprinkling, myriads of minute openings are left everywhere on the plate, enough being found in the required places for producing the colored rings. Of these the light takes advantage for producing a symmetrical effect, just as in the formation of the rainbow it selects those individual drops of moisture which serve its purpose, while the remainder of the drops are inoperative. A piece of very delicately ground glass accomplishes the same result. In the atmosphere, the place of the lycopodium powder is filled by the particles of moisture existing in the vesicular state; and the smaller these particles the larger will be the diameters of the coronæ which they produce. In this way these particles are proved to vary between the .001 and the .002 of one inch in diameter.*

Coronæ indicate the presence of the *cumulus* cloud; but halos imply the *cirrus* cloud, floating at great heights, and within the region of perpetual congelation. For halos are seen even in the summer and in the tropics. By revealing the incipient gathering of the cirrus cloud, they may foretell the approach of a storm.

Six hundred and twenty-first Meeting.

May 24, 1870. — ANNUAL MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary communicated letters relative to exchanges, and read a report from the Council proposing nominations for Foreign Honorary and Associate Membership.

The Treasurer presented his report for the past year, and read a synopsis of it. The report was received, to be entered on the records.

Professor Lovering reported from the Committee of Publication its expenditures for the past two years. The report was accepted.

Professor F. H. Storer reported for the Committee on the Library on the condition of the Library.

Professor Winlock reported, from the Rumford Committee, the completion of Vol. I. of Count Rumford's works, and recommendations of this committee for appropriations from the Rumford Fund. This report was accepted, and in accordance with its recommendations the following votes were passed: —

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* Kaemtz's Complete Course of Meteorology, p. 111.

Voted, That fifteen hundred dollars be appropriated from the Rumford Fund to continue the publication of Count Rumford's works.

Voted, That five hundred dollars in gold be appropriated from the Rumford Fund to be expended by Dr. B. A. Gould in the purchase of photometric and spectroscopic apparatus for an observatory at Cordova in the Argentine Republic.

The Recording Secretary returned the papers of Mr. W. B. Burden, for the Committee to which they were referred, with the recommendation that they be referred to the astronomical section of the Academy.

It was voted to adjourn this meeting, at its close, to the second Tuesday in June.

The following gentlemen were elected members of the Academy: —

Charles C. Perkins, of Boston, to be a Resident Fellow in Class III., Section 4.

Nathaniel Holmes, of Cambridge, to be a Resident Fellow in Class III., Section 1.

Raphael Pumpelly, of Cambridge, to be a Resident Fellow in Class II., Section 1.

George Derby, of Boston, to be a Resident Fellow in Class II., Section 3.

Simon Newcomb, of Washington, to be an Associate Fellow in Class I., Section 1.

Truman H. Safford, of Chicago, to be an Associate Fellow in Class I., Section 1.

Henry J. Clark, of Lexington, Ky., to be an Associate Fellow in Class II., Section 3.

Alexander Braun, of Berlin, to be a Foreign Honorary Member in Class II., Section 2, in the place of the late Von Martius.

Charles Merivale, of Oxford, to be a Foreign Honorary Member in Class III., Section 3, in the place of the late Dean Milman.

The annual election resulted in the choice of the following officers for the ensuing year: —

ASA GRAY, *President.*
GEORGE T. BIGELOW, *Vice-President.*
JOSEPH LOVERING, *Corresponding Secretary.*
EDWARD C. PICKERING, *Recording Secretary.*
CHARLES J. SPRAGUE, *Treasurer.*
FRANK H. STORER, *Librarian.*

Council.

THOMAS HILL,
JOSIAH P. COOKE, } of Class I.
JOHN B. HENCK,
LOUIS AGASSIZ,
JEFFRIES WYMAN, } of Class II.
CHARLES PICKERING,
ROBERT C. WINTHROP,
GEORGE E. ELLIS, } of Class III.
ANDREW P. PEABODY,

Rumford Committee.

JAMES B. FRANCIS,
MORRILL WYMAN,
EDWARD C. PICKERING,
JOSEPH WINLOCK,
WOLCOTT GIBBS,
JOSIAH P. COOKE,
FRANK H. STORER.

Committee of Finance.

ASA GRAY,
CHARLES J. SPRAGUE, } *ex officio*, by statute.
THOMAS T. BOUVÉ, by election.

The other Standing Committees were appointed, on the nomination of the President, as follows: —

Committee of Publication.

JOSEPH LOVERING,
JEFFRIES WYMAN,
FRANCIS J. CHILD.

Committee on the Library.

FRANCIS PARKMAN, CHARLES PICKERING,
JOHN BACON.

Committee to audit the Treasurer's Accounts.

CHARLES E. WARE, THEODORE LYMAN.

Professor Joseph Winlock exhibited a photograph of the sun taken with a lens of forty feet focus, and four inches aperture. As it is difficult to place a tube of this length in an inclined position, it is laid horizontally, and an image of the sun is reflected into it by a plane mirror of unsilvered glass. When this mirror was blackened on one side, it became heated to such an extent as to shorten the focus of the lens nearly three feet. The image obtained is about four inches in diameter, and is free from the distortion produced by an eye-piece. The exposure is instantaneous, and is effected by passing a diaphragm with a slit in it between the lens and mirror. A better effect is thus obtained than by the usual method of placing it near the plate-holder. The lens, which was made by Messrs. Clark and Sons, is not achromatic, as its slight curvature rendered this unnecessary. It was corrected for spherical aberration by means of an artificial star, produced by a soda flame, and a collimator, of an aperture somewhat greater than that of the lens.

The Corresponding Secretary presented the following annual report of the Council: —

Since the last report of the Council, the following gentlemen have been elected members of the Academy: —

William T. Brigham, of Boston, to be a Resident Fellow in Class II., Section 1.

Algernon Coolidge, of Boston, to be a Resident Fellow in Class II., Section 1.

Alfred P. Rockwell, of Boston, to be a Resident Fellow in Class I., Section 4.

Alpheus Hyatt, of Salem, to be a Resident Fellow in Class II., Section 3.

Edward S. Morse, of Salem, to be a Resident Fellow in Class II., Section 3.

Thomas W. Parsons, of Boston, to be a Resident Fellow in Class III., Section 4.

James M. Barnard, of Boston, to be a Resident Fellow in Class II., Section 3.

Henry L. Whiting, of Boston, to be a Resident Fellow in Class I., Section 2.

Nathaniel S. Shaler, of Cambridge, to be a Resident Fellow in Class II., Section 1.

During the same period, the Academy has lost five members by death, viz.: —

Two Resident Fellows, one Associate Fellow, and two Foreign Honorary Members.

Thomas Sherwin was born in Westmoreland, New Hampshire, March 26, 1799. His parents in a few years removed to New Ipswich in the same State, and soon afterwards to the adjoining town of Temple. At the age of eight, soon after the death of his mother, Thomas went to live with a relative, Dr. Crombie, of Temple, and remained with him six years. In 1813 he spent a short time in Ipswich Academy; but his father having met with misfortunes, he was compelled to leave school, and, in September of the same year, he was apprenticed at Groton, Massachusetts, to learn the trade of a clothier, — a trade which at that time appears to have consisted mainly in taking cloth as it came from the domestic looms, and fulling, dyeing, and dressing it for the market. Here he remained eight years, working diligently at his trade, and winning the esteem and confidence of his employers. He was able to attend the district school two months in the year; but his natural love of learning often led him to devote one or two hours to study after working at the mill until ten o'clock at night.

His desire to obtain a college education had now become so strong that he left his trade, and, after teaching a district school in Harvard for a short time, began his preparation for college at the academy in Groton in April, 1820. He completed it at the New Ipswich Academy, and entered Harvard College in 1821. Here, notwithstanding his imperfect preparation, he soon placed himself among the foremost scholars, particularly in mathematics, and graduated with honor in

1825. For a year he had charge of the academy at Lexington, and was then appointed tutor in mathematics in the College. In 1827 he commenced civil engineering with Loammi Baldwin, and, in the same year, under James Hayward, was employed on the preliminary survey of the Boston and Providence Railroad. Relinquishing this business on account of a severe illness, he in 1828 opened a private school for boys, in Boston, and the next year was elected sub-master of the English High School. In 1837 he was elected master of the school, and continued to hold the position to the time of his death.

As master of the English High School, Mr. Sherwin gained his highest distinction. The best work of his life was here. He inspired his pupils with his own love of thoroughness, and taught them, not more by precept than by example, to think for themselves, and to aim at a noble manhood. Under his charge the school ranked among the best in the country. Indeed, Mr. Fraser, in his report to the British Parliament on the schools of this country, says: "The English High School struck me as the model school of the United States."

In all educational matters Mr. Sherwin took an active interest. He aided in the establishment of the American Institute of Instruction and of the Massachusetts State Teachers' Association, and became President of each of these bodies. He was also one of the founders of the Massachusetts Teacher, and for several years had charge of its mathematical department. He shared in the organization of the Massachusetts Institute of Technology, and, as a member of its government, was one of its most active and earnest promoters.

Mr. Sherwin wrote various addresses and lectures on educational subjects, and contributed several papers to the Mathematical Monthly. In connection with Mr. S. P. Miles, he published a collection of Mathematical Tables. He was the author, also, of two works on Algebra, — an "Elementary Treatise on Algebra," and a "Common School Algebra," — both of which have long held a high place in our schools.

Mr. Sherwin was elected a Fellow of this Academy in 1836. In 1868 he was elected a member of the New England Historic-Genealogical Society.

Mr. Sherwin died, very suddenly, July 23, 1869. On that day, not feeling quite well, he consulted a physician, walked home in a cheerful mood, and, after some conversation with his family and a walk in his garden, went to his room, took a book, and in a moment departed. In all the relations of life Mr. Sherwin sustained a high reputation. In boyhood diligent and faithful, in youth persevering in his efforts to secure a liberal education, as a teacher attaining rare success by conscientious devotion to the best interests of his pupils, patriotic when his country was in danger, zealous in promoting the cause of sound education, and full of kindly affection towards all, he has left a memory that will be long and lovingly cherished.

NATHANIEL LANGDON FROTHINGHAM was born in Boston, July 23, 1793. He was graduated at Harvard University in 1811. He pursued the study of theology at Cambridge, under the direction of Dr. Ware, Senior, and from 1812 to 1815 inclusive officiated in the College as instructor in Rhetoric and Oratory. In 1815 he was ordained pastor of the First Church in Boston. In 1818 he married Ann Gorham, daughter of Peter C. Brooks. In 1836 he received the degree of S. T. D. from Harvard University. In 1850 he resigned his parochial charge, retaining the undivided respect and affection of his people, and continuing, until disabled by bodily infirmity, to take an active and efficient interest in the prosperity of the parish, and in the labors and services of his successor in its ministry. His life, during his retirement, was devoted mainly to literary pursuits, hardly impeded by the gradual failure of sight, which terminated in total blindness. Other eyes replaced his own for several years, and his mind retained its clearness, vigor, and fruitfulness for many months after his vision was closed upon the outward world. For the last two or three years, however, disease and infirmity have incapacitated him both for labor and for enjoyment, and life was becoming a weariness and a burden, when it was mercifully closed on the 4th of April, 1870.

Dr. Frothingham's distinction lay in the purity, keenness, delicacy, and high culture of the æsthetic nature. In other respects the peer of able and accomplished men, in this he could have had, if here and there an equal, no superior. Taste was in him genius, wisdom, and power. It imparted a new and rare beauty, even to trite thoughts; it crystallized his scholarship in the most graceful forms; it gave law to his most indifferent words and acts.

He was a scholar by inclination and by lifelong habit. He was well versed equally in classical and in modern literature. He became familiar with the German language at a very early period, and was well read in German theology, while intimately conversant with the poetry and imaginative literature to which that language is the key. By no means narrowly utilitarian, he loved all knowledge for its own sake, without reference to its availableness for immediate service; and he thus became possessed of much of that rare and recondite erudition which enriches and fertilizes the mind, though it may contribute but little to one's professional ability or fame.

As a preacher, Dr. Frothingham held a high and somewhat unique position. His sermons were most appreciated by minds of the largest culture, and yet in thought and in diction they were not above the comprehension of any person of moderate intelligence. Here his exquisite taste gave at once law, scope, and limit. Quaint, but never irreverent; elegant in style, yet without lapsing into euphuism; never forgetting the solemnity of time, place, and purpose, yet instinctively shunning the mere commonplaces of devout thought; solicitous always to instruct and impress his hearers, and ready to avail himself, for this end, of as wide a diversity of topics, illustrations, and allusions, as was consistent with the sacredness of the occasion, — he wrote few sermons that were not listened to with vivid interest, and held in enduring remembrance. Yet his sermons by no means indicated his full capacity of grappling with the highest and the greatest subjects. He seemed unwilling to write anything that was not whole and complete in itself; and there are many topics on which it is impossible to write a perfectly rounded and finished treatise that can be read in half an hour. He essayed no subject which could not be thus compressed naturally and gracefully. His range therefore, as a preacher, was broad, rather than high or deep; but within that range few ministers have been so uniformly apt, rich, and edifying. He was peculiarly felicitous, not only in his treatment of special occasions for pulpit utterance, but in creating such occasions; so that whatever had worthily claimed the attention or interest of his hearers during the week was not unlikely on Sunday to be presented in its religious aspects and lessons.

As a poet, Dr. Frothingham won indeed a high reputation, but a fame far below his merit. As he wrote no long poem, and published no collection of his poetry till very late in life, the public, and even his friends, awoke but slowly and tardily to the recognition of his genius in this department. But as from time to time a hymn or a metrical composition, in conception a gem of pure radiance in a setting of wonderful beauty, appeared under his signature, in the programme of a religious or civic festival, or in the pages of a monthly or quarterly, it was felt more and more that he was indeed a poet by divine right and gift; and there are some of his lyrics that can hardly fail to perpetuate his name, when all other memorials of him shall have passed away. Here, too, we mark not only "the vision and the faculty divine," but equally the unerring taste, incapable of an incongruous image, a mixed metaphor, an unapt epithet, a halting rhythm, or a forced rhyme. He professed to translate a great many German poems; but he made them all his own. He is, indeed, in these versions, true to the original; but he transposes rather than translates it, seeking not so much for synonymous words and phrases, as for equivalent force and beauty of expression.

In character Dr. Frothingham was worthy of his sacred profession, of the affection with which he was regarded by all who knew him well, and of the general reverence which followed him to his retirement and to his grave. In manners and conversation his strongly marked individuality was so held in check, alike by good taste and by benevolence, as to be piquant indeed, but never otherwise than genial and attractive. He had many warm friends, perhaps few intimates. Generous, hospitable, kind, tenderly thoughtful for the feelings and the rights of others, he did untold good in those quiet, unostentatious ways in which genuine philanthropy can work without shout or song. He was conservative both from taste and from principle; but his conservatism had in it no bitterness or exclusiveness, — he only preferred doing good in his accustomed ways, while he conceded cordially the freedom of choice he claimed. As a pastor, he was tenderly beloved; and in all professional, social, and domestic relations he has left only the most precious and blessed memories.

Dr. Frothingham's only published volumes were "Sermons in the Order of a Twelvemonth" and two volumes of Poems. Of occasional sermons and other pamphlets he printed many. He contributed largely to our best periodical literature, and to every important publication of that kind issued in Boston, for considerably more than half a century; and his papers thus published, and because of their form forgotten, would fill nearly half as many volumes as they covered years.

THEODORE STRONG was born at South Hadley, Massachusetts, in July, 1790, and died at New Brunswick, New Jersey, February 1, 1869. His father was a clergyman, and there had been an unbroken line of ministers in the family of his mother for eleven generations. He took his bachelor's degree at Yale in 1812, and was immediately appointed tutor in Mathematics at Hamilton College, Clinton, New York. He was soon after appointed Professor of Mathematics and Natural Philosophy, and held that chair until 1827, when he was called to the similar chair made illustrious by the genius of Dr. Robert Adrain, at Rutgers College, New Brunswick, New Jersey, where he continued in active duty until 1862. He married, in 1819, Lucy Dix, of Boston, who survives him, with three of their seven children; one son of great promise, who was in the army, fell during the late civil war.

As a teacher Dr. Strong was remarkable for his faith in spontaneous effort, and his utter want of faith in any sort of coercion; he would arouse the enthusiasm of his pupils to study subjects, not compel them to study books. With this faith in the value of spontaneous effort, his desire was more earnest to affect the character of the students than merely to give them specific knowledge; and with his firm convictions of the truth of the Christian religion, he sought ever earnestly to awaken religious life in his scholars, as the most effectual means of arousing intellectual life.

All his convictions, whether in religion, philosophy, or politics, were very strong, held with extreme tenacity, and, if attacked, defended with courteous but earnest warmth. It was said that he never failed, in the College Faculties with which he was connected, to bring the majority to his views. His conclusions were never hasty; he was a patient thinker and careful reader, and took especial pleasure in the writings of the deeper English theologians. His firmness of conviction gave pleasure even to those who differed from him; no man could resist the attraction of his frank, honorable self-poise; and it was good also to look upon a man of such robust health, maintained by habits of great activity and cheerful self-control.

His mathematical powers lay rather in the direction of geometry than in analysis, yet his analytical power was also great. He was too far advanced in years, at the time when the modern rapid developments began, to be much affected by them, but has himself taken important steps.

The following is an imperfect list of Dr. Strong's mathematical writings: —

1. Twenty-two communications in Gill's Mathematical Miscellany.
2. Seven communications in the Cambridge Miscellany.
3. Twenty-two papers in the American Journal of Science, viz.: —
    On Trigonometric and Diophantine Problems, Vols. I. and XXXI.

Problems with Geometrical Construction, Vol. II.
On the Binomial Theorem, Vol. XII.
On Central Forces, Vols. XVI., XVII., XIX., XXI., XXII.
Capillary Attraction, Vol. XVIII.
On the Motion of a System of Bodies, Vols. XXIV., XXV., XXVI.
Parallelogram of Forces, Vols. XXVI., XXIX.
Composition and Resolution of Forces, Vol. XXVIII.
Variation of Constants in Elliptic Motion, Vol. XXX.
Virtual Velocities, Vols. XLII., XLIII.
Differential Equations, Vol. XLII.
Differential Calculus, and Taylor's Theorem, Vol. XLV.
Exponential and Logarithmic Theorems, Vol. XLVIII.

4. A Paper in Runkle's Mathematical Monthly for April, 1860, on the Extraction of Roots, and one in June, 1861, on the Equilibrium of the Lever.

5. A Treatise on Elementary and Higher Algebra, New York, 1859.

6. A Treatise (in MSS.) on the Differential and Integral Calculus.

It would be difficult to find in the history of science a character more simple, more noble, or more symmetrical in all its parts than that of THOMAS GRAHAM, and he will always be remembered as one of the most eminent of those great students of nature, who have rendered our Saxon race illustrious. He was born of Scotch parents in Glasgow in the year 1805, and in that city, where he received his education, all his early life was passed. In 1837 he went to London as Professor of Chemistry in the newly established London University now called University College, and he occupied this chair until the year 1855, when he succeeded Sir John Herschel as Master of the Royal Mint, a post which he held to the close of his life. His death, on the 16th of September last, at the age of sixty, was caused by no active disease, but was simply the wearing out of a constitution enfeebled in youth by privations voluntarily and courageously encountered that he might devote his life to scientific study. As with all earnest students, that life was uneventful, if judged by ordinary standards; and the records of his discoveries form the only materials for his biography. Although one of the most successful investigators of Physical Science, the late Master of the Mint had not that felicity of language or that copiousness of illustration, which added so much to the popular reputation of his distinguished contemporary, Faraday; but his influence on the progress of science was not less marked or less important. Both of these eminent men were for a long period of years best known to the English public as teachers of Chemistry, but their investigations were chiefly limited to physical problems; yet, although both cultivated the border ground between Chemistry and Physics, they followed wholly different lines of research. While Faraday was so successfully developing the principles of electrical action, Graham with equal success was investigating the laws of molecular motion. Each followed with wonderful constancy, as well as skill, a single line of study from first to last, and to this concentration of power their great discoveries are largely due.

One of the earliest and most important of Graham's investigations, and the one which gave the direction to his subsequent course of study, was that on the diffusion of gases. It had already been recognized that impenetrability in its ordinary sense is not, as was formerly supposed, a universal quality of matter. Dalton had not only recognized that aëriform bodies exhibit a positive tendency to mix, or to penetrate through each other, even in opposition to the force of gravity, but had made this quality of gases the subject of experimental investigation. He inferred, as the result of his inquiry, "that different gases afford no resistance to each other; but that one gas spreads or expands into the space occupied by another gas, as it would rush into a vacuum; at least, that the resistance which the particles of one gas offer to those of another is of a very imperfect kind, to be compared to the resistance which stones in the channel of a stream oppose to the flow of running water." But although this theory of Dalton was essentially correct and involved the whole truth, yet it was supported by no sufficient evidence, and he failed to perceive the simple law which underlies this whole class of phenomena.

Graham, "on entering on this inquiry, found that gases diffuse into the atmosphere with different degrees of ease and rapidity." This was first observed by allowing each gas to diffuse from a bottle into the air through a narrow tube in opposition to the solicitation of gravity. Afterwards an observation of Doebereiner on the escape of hydrogen gas by a fissure or crack in a glass receiver caused him to vary the conditions of his experiments, and led to the invention of the well-known "Diffusion Tube." In this simple apparatus a thin septum of plaster of Paris is used to separate the diffusing gases, which, while it arrests in a great measure all direct currents between the two media, does not interfere with the molecular motion. Much later, Graham found in prepared graphite a material far better adapted to this purpose than the plaster, and he used septa of this mineral to confirm his early results, in answer to certain ill-considered criticisms in Bunsen's work on Gasometry. These septa he was in the habit of calling his "atomic filters." By means of the diffusion tube Graham was able to *measure accurately the relative times of diffusion of different gases*, and he found that *equal volumes of any two gases interpenetrate each other in times which are inversely proportional to the square roots of their respective densities*, and this fundamental law was the greatest discovery of our late Foreign Associate. It is now universally recognized as one of the few great cardinal principles which form the basis of Physical Science.

It can be shown, on the principles of pneumatics, that gases should rush into a vacuum with velocities corresponding to the numbers which have been found to express their diffusion times; and, in a series of experiments on what he calls the "*Effusion*" of gases, Graham confirmed by trial this deduction of theory. In these experiments a measured volume of the gas was allowed to find its way into the vacuous jar through a minute aperture in a thin metallic plate, and he carefully distinguished between this class of phenomena and the flowing of gases through capillary tubes into a vacuum, in which case, however short the tube, the effects of friction materially modify the result. This last class of phenomena Graham likewise investigated, and designated by the term "Transpiration."

While, however, it thus appears that the results of Graham's investigation were in strict accordance with Dalton's theory, it must also be evident that Graham was the first to observe the exact numerical relation which obtains in this class of phenomena, and that all-important circumstance entitles him to be regarded as the discoverer of the law of Diffusion. The law, however, as first enunciated, was purely empirical, and Graham himself says that something more must be assumed than that gases are vacua to each other, in order to explain all the phenomena observed; and according to his original view this representation of the process was only a convenient mode of expressing the final result. Such has proved to be the case.

Like other great men, Graham built better than he knew. In the progress of Physical Science during the last twenty-five years, two principles have become more and more conspicuous, until at last they have completely revolutionized the philosophy of Chemistry. In the first place it has appeared that a host of chemical as well as of physical facts are co-ordinated by the assumption that all substances in the state of gas have the same molecular volume, or, in other words, contain the same number of molecules in a given space; and in the second place, it has become evident that the phenomena of heat are simply the manifestations of molecular motion. According to this view, the temperature of a body is the *vis viva* of its molecules; and since all molecules at a given temperature have the same *vis viva*, it follows that the molecules must move with velocities which are inversely proportional to the square roots of the molecular weights. Moreover, since the molecular volumes are equal, and the molecular weights therefore proportional to the densities of the aëriform bodies in which the molecules are the active units, it also follows that the velocities of the molecules in any two gases are inversely proportional to the square roots of their respective densities. Thus the simple numerical relations first observed in the phenomena of diffusion are the direct result of molecular motion, and it is now seen that Graham's empirical law is included under the fundamental laws of motion. Thus Graham's investigation has become the basis of the new science of molecular mechanics, and his measurements of the rates of diffusion prove to be the measures of molecular velocities.

From the study of diffusion Graham passed by a natural transition to the investigation of a class of phenomena which, although closely allied to the first, as to the effects produced, differ wholly in their essential nature. Here also he followed in the footsteps of Dalton. This distinguished chemist had noticed that a bubble of air separated by a film of water from an atmosphere of carbonic anhydride gradually expanded until it burst. In like manner a moist bladder, half filled with air and tied, if suspended in an atmosphere of the same material, becomes in time greatly distended by the insinuation of this gas through its substance. This effect cannot be the result of simple diffusion, for it is to be remembered that the thinnest film of water, or of any liquid, is absolutely impermeable to a gas as such, and, moreover, only the carbonic anhydride passes through the film, very little or none of the air escaping outward. The result depends, first, upon the solution of the carbonic anhydride by the water on one surface of the film; secondly, on the evaporation into the air, from the other surface, of the gas thus absorbed. Similar experiments were made by Drs. Mitchell and Faust, and others, in which gases passed through a film of india-rubber, entering into a partial combination with the material on one surface, and escaping from it on the other.

Graham not only considerably extended our knowledge of this class of phenomena, but also gave us a satisfactory explanation of the mode in which these remarkable results are produced. He recognized in these cases the action of a feeble chemical force, insufficient to produce a definite compound, but still capable of determining a more or less perfect union, as in the case of simple solution. He also distinguished the influence of mass in causing the formation or decomposition of such weak chemical compounds. The conditions of the phenomena under consideration are simply these: —

First. A material for the septum capable of forming a feeble chemical union with the gas to be transferred.

Secondly. An excess of the gas on one side of the film and a deficiency on the other.

Thirdly. Such a temperature that the unstable compound may orm at the surface, where the aëriform constituent is present in large mass, while it decomposes at the opposite surface, where the quantity is less abundant.

One of the most remarkable results of Graham's study of this peculiar mode of transfer of aëriform matter through the very substance of solid bodies was an ingenious method of separating the oxygen from the atmosphere. The apparatus consisted simply of a bag of india-rubber kept distended by an interior framework, while it was exhausted by a Sprengel pump. Under these circumstances the selective affinity of the caoutchouc determines such a difference in the rate of transfer of the two constituents of the atmosphere that the amount of oxygen in the transpired air rises to forty per cent, and by repeating the process nearly pure oxygen may be obtained. It was at first hoped that this method might find a valuable application in the arts, but in this Graham was disappointed; for the same result has since been effected by purely chemical methods, which are both cheaper and more rapid.

These experiments on india-rubber naturally led to the study of similar effects produced with metallic septa, which, although to some extent previously observed in passing gases through heated metallic tubes, had been only imperfectly understood. Thus, when a stream of hydrogen or carbonic oxide is passed through a red-hot iron tube, a no inconsiderable portion of the gas escapes through the walls. The same is true to a still greater degree when hydrogen is passed through a red-hot tube of platinum, and Graham showed that through the walls of a tube of palladium hydrogen gas passes, under the same conditions, almost as rapidly as water through a sieve. Moreover, our distinguished Associate proved that this rapid transfer of gas through these dense metallic septa was due, as in the case of the india-rubber, to an actual chemical combination of its material with the metal, formed at the surface, where the gas is in excess, and as rapidly decomposed on the opposite face of the septum. He not only recognized as belonging to this class of phenomena the very great absorption of hydrogen by platinum plate and sponge in the familiar experiment of the Doebereiner lamp, but also showed that this gas is a definite constituent of meteoric iron, — a fact of great interest from its bearing on the meteoric theory.

We are thus led to Graham's last important discovery, which was the justification of the theory we have been considering, and the crowning of this long line of investigation. As may be anticipated from what has been said, the most marked example of that order of chemical compounds, to which the metallic transpiration of aëriform matter we have been considering is due, is the compound of palladium with hydrogen. Graham showed that when a plate of this metal is made the negative pole in the electrolysis of water, it absorbs nearly one thousand times its volume of hydrogen gas, — a quantity approximatively equivalent to one atom of hydrogen to each atom of palladium. He further showed that the metal thus becomes so profoundly altered as to indicate that the product of this union is a definite compound. Not only is the volume of the metal increased, but its tenacity and conducting power for electricity are diminished, and it acquires a slight susceptibility to magnetism, which the pure metal does not possess. The chemical qualities of this product are also remarkable. It precipitates mercury from a solution of its chloride, and in general acts as a strong reducing agent. Exposed to the action of chlorine, bromine, or iodine, the hydrogen leaves the palladium and enters into direct union with these elements. Moreover, although the compound is readily decomposed by heat, the gas cannot be expelled from the metal by simple mechanical means.

These facts recall the similar relations frequently observed between the qualities of an alloy and those of the constituent metals, and suggest the inference made by Graham, that palladium charged with hydrogen is a compound of the same class, — a conclusion which harmonizes with the theory long held by many chemists, that hydrogen gas is the vapor of a very volatile metal. This element, however, when combined with palladium, is in a peculiarly active state, which sustains somewhat the same relation to the familiar gas that ozone bears to ordinary oxygen. Hence Graham distinguished this condition of hydrogen by the term "Hydrogenium." Shortly before his death a medal was struck at the Royal Mint from the hydrogen palladium alloy in honor of its discovery; but although this discovery attracted public attention chiefly on account of the singular chemical relations of hydrogen, which it brought so prominently to notice, it will be remembered in the history of science rather as the beautiful termination of a life-long investigation, of which the medal was the appropriate seal.

Simultaneously with the experiments on *gases*, whose results we have endeavored to present in the preceding pages, Graham carried forward a parallel line of investigation of an allied class of phenomena, which may be regarded as the manifestations of molecular motion in *liquid* bodies. The phenomena of diffusion reappear in liquids, and Graham carefully observed the times in which equal weights of various salts dissolved in water diffused from an open-mouth bottle into a large volume of pure water, in which the bottle was immersed. He was not, however, able to correlate the results of these experiments by such a simple law as that which obtains with gases. It appeared, nevertheless, that the rate of diffusion differs very greatly for the different soluble salts, having some relation to the chemical composition of the salt which he was unable to discover. But he found it possible to divide the salts into groups of equi-diffusive substances, and he showed that the rates of diffusion of the several groups bear to one another simple numerical ratios.

More important results were obtained from the study of a class of phenomena corresponding to the transpiration of gases through india-rubber or metallic septa. These phenomena, as manifested in the transfer of liquids and of salts in solution through bladder, or a similar membrane, had previously been frequently studied under the names of exosmose and endosmose, but to Graham we owe the first satisfactory explanation. As in the case of gases, he referred these effects to the influence of chemical force, combination taking place on one surface of the membrane, and the compound breaking up on the other, the difference depending, as in the previous instance, on the influence of mass.

He also swept away the arbitrary distinctions made by previous experimenters, showed that this whole class of phenomena are essentially similar, and called this manifestation of power simply "osmose."

While studying osmotic action, Graham was led to one of his most important generalizations, — the recognition of the crystalline and amorphous states as fundamental distinctions in chemistry. Bodies in the first state he called crystalloids; those in the last state, colloids (resembling glue). That there is a difference in structure between crystalloids, like sugar or felspar, and colloids, like barley candy or glass, has of course always been evident to the most superficial observer; but Graham was the first to recognize in these external differences two fundamentally distinct conditions of matter not peculiar to certain substances, but underlying all chemical differences, and appearing to a greater or less degree in every substance. He showed that the power of diffusion through liquids depends very much on these fundamental differences of condition, — sugar, one of the least diffusible of the crystalloids, diffusing fourteen times more rapidly than caromel, the corresponding colloid. He also showed that, in accordance with the general chemical rule, while colloids readily combine with crystalloids, bodies in the same condition manifest little or no tendency to chemical union. Hence in osmose, where the membranes employed are invariably colloidal, the osmotic action is confined almost entirely to crystalloids, since they alone are capable of entering into that combination with the material of the septum on which the whole action depends.

On the above principles Graham based a simple method of separating crystalloids from colloids, which he calls "dialysis," and which was a most valuable addition to the means of chemical analysis. A shallow tray, prepared by stretching parchment paper (an insoluble colloid) over a gutta-percha hoop, is the only apparatus required. The solution to be "dialyzed" is poured into this tray, which is then floated on pure water, whose volume should be eight or ten times greater than that of the solution. Under these conditions the crystalloids will diffuse through the porous septum into the water, leaving the colloids on the tray, and in the course of a few days a more or less complete separation of the two classes of bodies will have taken place. In this way arsenious acid and similar crystalloids may be separated from the colloidal materials with which, in the case of poisoning, they are usually found mixed in the animal juices or tissues.

But besides having these practical applications, the method of dialysis in the hands of Graham yielded the most startling results, developing an almost entirely new class of bodies as the colloidal forms of our most familiar substances, and justifying the conclusion that the colloidal as well as the crystalline condition is an almost universal attribute of matter. Thus, he was able to obtain solutions in water of the colloidal states of aluminic, feoric, chromic, stannic, metastannic, titanic, molybdic, tungstic, and silicic hydrates, all of which gelatinize under definite conditions like a solution of glue. The wonderful nature of these facts can be thoroughly appreciated only by those familiar with the subject, but all may understand the surprise with which the chemist saw such hard, insoluble bodies as flint dissolved abundantly in water and converted into soft jellies. These facts are, without doubt, the most important contributions of Dr. Graham to pure chemistry.

In this sketch of the scientific career of our late Associate, we have followed the logical, rather than the chronological, order of events, hoping thus to render the relations of the different parts of his work more intelligible. It must be remembered, however, that the two lines of investigation we have distinguished were in fact interwoven, and that the beautiful harmony which his completed life presents was the result, not of a preconceived plan, but of a constant devotion to truth, and a childlike faith, which unhesitatingly pressed forward whenever nature pointed out the way.

Although the investigations of the phenomena connected with the molecular motion in gases and liquids were by far the most important of Dr. Graham's labors, he also contributed to chemistry many researches which cannot be included under this head. Of these, which we may regard as his detached efforts, the most important was his investigation of the hydrates and other salts of phosphorus. It is true that the interpretation he gave of the results has been materially modified by the modern chemical philosophy, yet the facts which he established form an important part of the basis on which that philosophy rests. Indeed, it seems as if he almost anticipated the later doctrines of types and polybasic acids, and in none of his work did he show more discriminating observation or acute reasoning. A subsequent investigation on the condition of water in several crystalline salts and in the hydrates of sulphuric acid is equally remarkable. Lastly, Graham also made interesting observations on the combination of alcohol with salts, on the process of etherification, on the slow oxidation of phosphorus, and on the spontaneous inflammability of phosphuretted hydrogen. It would not, however, be appropriate in this place to do more than enumerate the subjects of these less important studies; and we have therefore only aimed in this sketch to give a general view of the character of the field which this eminent student of nature chiefly cultivated, and to show how abundant was the harvest of truth which we owe to his faithful toil.

Graham was not a voluminous writer. His scientific papers were all very brief, but comprehensive, and his "Elements of Chemistry" was his only large work. This was an admirable exposition of chemical physics, as well as of pure chemistry, and gave a more philosophical account of the theory of the galvanic battery than had previously appeared. Our late Associate was fortunate in receiving during life a generous recognition of the value of his labors. His membership was sought by almost all the chief scientific societies of the world, and he enjoyed to a high degree the confidence and esteem of his associates. Indeed, he was singularly elevated above the petty jealousies and belittling quarrels, which so often mar the beauty of a student's life, while the great loveliness and kindliness of his nature closely endeared him to his friends. He was never married, keeping house with a sister at No. 4 Gordon Square, where he dispensed a liberal hospitality, which has been enjoyed by many of our scientific countrymen who have visited London during the last twenty years.

In concluding, we must not forget to mention that most genial trait of Graham's character, his sympathy with young men, which gave him great influence as a teacher in the College with which he was long associated. There are many now prominent in the scientific world who have found in his encouragement the strongest incentive to perseverance, and in his approval and friendship the best reward of success.

FREDERIC OVERBECK was born at Lubeck on the 2d of July, 1789, and commenced his studies in art at a very early age. In 1806 he entered the Academy of Fine Arts at Vienna. His natural tendencies, fostered by the counsels of Eberhard Wachter, soon led him to the exclusive study of the Pre-Raphaelite painters. This brought him into such open opposition to the professors, whose principles were those of the classical school of Mengs and David, that he was dismissed from the Academy, and in the year 1810 went to Rome, where he found himself in a thoroughly congenial atmosphere. Six years later, when Niebuhr arrived there as Prussian ambassador, he found Overbeck and other young artists, who were then laying the foundations of the new school of painting in Germany, divided into two parties, professing utterly opposed principles. These were the Nazarenes, so called from their mode of life and their austerity of demeanor, whose leaders, Overbeck, Wilhelm, Schadow, and Veit, late converts to Romanism, looked upon art as the servant of religion, and lived like monks in the old convent of San Isidoro, preparing their simple meals in the kitchen of the convent; and the Pagans, as they might have been denominated, who were devout adorers of the antique. This latter party numbered Thorwaldsen, Koch, and Schlick in its ranks. Cornelius stood midway between the two parties, but his dislike of the proselytism which was practised by the Nazarenes rather impelled him in the opposite direction; and, although a Catholic, he openly said that when they made their first convert he would become a Protestant.

Niebuhr tells us that the Catholicism of Cornelius was at bottom nothing more than the creed of the old Protestants, "thanks to the training which he had received from a pious, though by no means bigoted mother"; but Overbeck, he adds, "is, on the contrary, an enthusiast, and quite illiberal; he is a very amiable man and endowed with a magnificent imagination, but incapable by nature of standing alone, and by no means so clear-headed as he is practical."

In the society of such men as Niebuhr, Bunsen, and Brandis these artists met on the most friendly terms, though certain topics (*teste* Niebuhr) were necessarily excluded from conversation on account of the Catholicism of Overbeck and Schadow.

A few years after Overbeck had settled at Rome, the Prussian Consul-General, Salomm Bartholdy (Mendelssohn's uncle), proposed to him, together with Veit, Schadow, and Cornelius, to decorate with frescos a room in the Palazzo Zuccheri, where he resided, offering himself to meet all material expenses. Thus these young and ardent spirits were enabled to carry out their long-cherished project of reviving an almost forgotten art in the very city where its greatest masterpieces had been executed, nearly three centuries before, by the hands of Raphael and Michael Angelo.

The history of Joseph was selected for treatment, and Overbeck painted the episode of Joseph sold by his brethren to the Ishmaelites. In this, his first important work, the young artist displayed his life-long merits and defects. We need go no farther to understand him; for, unlike men of original genius, Overbeck had but one style, or, to speak more correctly, but one manner, which too often degenerated into mannerism. He was in no sense progressive; his art wanted individual life; it was a plant carefully trained after the outward pattern of a phase of art which still keeps its high place because it was the spontaneous growth and vital expression of the age which produced it, — a ghost clad in Pre-Raphaelite garments, cold, correct, full of evidences of careful study, but never inspired, never living. Now and then, as in this very fresco, or in his great picture of The Influence of Religion upon the Arts in the Staedel Institute at Frankfort, we are charmed by a naive grace and simplicity; but this is because we are thinking of Perugino, rather than of Overbeck.

After completing their work at the Palazzo Zuccheri, Overbeck, Schadow, and Cornelius painted frescos, representing scenes selected from the poems of the four great Italian poets, in the casino of the villa of Prince Massimo, near St. John Lateran. Overbeck took his subject from Tasso; but he was not the man required for such a work, and could not rise to the same level as when his pencil was employed upon Biblical scenes. In dealing with these he was in his element, and the long series of charcoal drawings which he commenced, while living at the Palazzo Cenci, for an illustrated German Bible, are, as it seems to us, by far his best works. For color he had no feeling. His oil pictures are positively disagreeable from their leaden tones, false scale of crude tints, and inharmonious juxtaposition of colors; but his simple outline drawings, only slightly shaded, are masterly. His most important paintings, besides those already mentioned, are the Miracle of St. Francis and the Roses, in the Church of Sta. Maria degli Angeli at Assisi; Christ in the Garden, at Hamburg; and the Entrance of Christ into Jerusalem, in the Church of the Virgin at Lubeck. After residing fifty-nine years at Rome, Overbeck died there of rapid consumption on the 12th of November, 1869.

No one who has ever seen him can forget his striking appearance. Like his art, he was an anachronism. Clad in a long purple robe bordered with gray fur, and wearing a cap of the same material and trimmings upon his head, grave and sober in his walk and conversation, he looked as if he had stepped out of one of Holbein's pictures. Could he have been set down in the Rotterdam of the sixteenth century, he might have met Erasmus without startling him as he startled the stranger of our day who saw him for the first time in the streets of Rome or in his studio on the Esquiline.

He was so gentle and kindly that all felt drawn towards him, while at the same time his reverend aspect inspired those who approached him with veneration. The purity of his life was reflected in his person, as in his art, and the atmosphere which surrounded him was so far removed from the tumultuous rush of modern existence, that when you left him, and plunged again into the world as it is, you carried away a thousand longings for that world of which he seemed a part. Overbeck was a priest of Art, to whom it was a holy thing, and never a means of gaining money or men's applause.

The thanks of the Academy were voted to the retiring Secretary, Mr. Wright, for his long and faithful service.

Six hundred and twenty second Meeting.

June 14, 1870. — Adjourned Annual Meeting.

The President in the chair.

Letters in acknowledgment of their election as Fellows were received from C. C. Perkins, Esq., Professor N. Holmes, and Dr. George Derby.

Dr. J. B. S. Jackson was appointed to the Auditing Committee in place of Dr. Ware, absent in Europe.

Professor Lovering proposed that Chapter I., Section II., of the Statutes of the Academy, be amended by the substitution of the word "five" for "three," and also for the word "two," so that the article shall read "and an annual assessment of five dollars, with such additional sum, not exceeding five dollars, as the Academy shall, by a standing vote, from time to time determine." Referred to a committee consisting of Messrs. Lovering, Clark, and Quincy.

The President called attention to the fact, that, in the new Dictionary of Latin and Byzantine Greek by Professor Sophocles, no mention is made of the "Glossary," published by the Academy as the seventh volume of its Memoirs, of which the later work is a development. He had reason to believe that the omission would be supplied.

The Vice-President and Professors Parsons and Holmes were appointed a committee to consider whether the cost of printing Professor Lovering's memoir upon the Aurora Borealis could rightly be defrayed from the Rumford Fund, and also what disposition should be made of any proceeds which might accrue from the republication by the Academy of Count Rumford's works.

It was voted to appropriate one hundred and fifty dollars to be expended by the Library Committee, and three hundred and fifty dollars to be expended by the Committee on Publications.

Mr. Porter C. Bliss made a communication on the Ethnology of the Indian tribes of the southern part of South America.

The President read by title the following papers: —

1. *Reconstruction of the Order Diapensiaceæ.* By Asa Gray.

The name of this group was first used by Link, for a tribe of *Convolvulaceæ*, — which was wide of the mark. But the order was founded by Lindley in 1836 (Introd. Nat. Syst. ed. 2). The two genera and species of which it was constituted, however, have on the one hand been appended to *Ericaceæ*, as by Endlicher and Dr. Hooker, or on the other referred to *Polemoniaceæ*, as by Don, Fries, and Alph. DeCandolle. Decaisne, indeed, keeps up the order (Decaisne and LeMaout, Traité Gen. Bot.); but as he intercalates it between the *Pyroleæ* and *Vaccineæ*, admitting those and kindred groups as orders, his view coincides with that of Endlicher and Hooker. In the second and subsequent editions of the Man. Bot. N. United States, I had followed the other course. But, after an attentive study of the *Polemoniaceæ* of the Northern hemisphere, I can no longer recognize the relationship. The plants in question have neither the gamophyllous calyx, nor the convolute æstivation of the corolla, nor the usually three-cleft style, nor the hypogynous disk, nor the pretty large embryo with flattened or foliaceous cotyledons of *Polemoniaceæ*; nor do the latter anywhere show an approach to the stamens of *Diapensia*. That these points of difference from *Polemoniaceæ* are all, with one exception, points of agree-ment with *Ericaceæ*, must be conceded, as also the similarity of habit. But the complete absence of an hypogynous disk, and the insertion of the stamens upon (instead of with) the corolla, are characters which ought to weigh heavily, in the absence of all the peculiar marks of *Ericaceæ*, — such, for instance, as the indusiate stigma, tetrahedral pollen, &c. Dr. Hooker, after due mention and consideration of these points (in Kew Jour. Bot. 9, p. 372), yet finds, in his remarkable genus *Diplarche*, strong evidence of a transition between *Diapensia* and *Loiseleuria*, his genus having one set of stamens adnate high up on a corolla which much resembles in shape that of *Diapensia Lapponica.* But *Diplarche* exhibits the disk, the stigma, and the pollen characteristic of *Ericaceæ*, and has neither the filament nor the anther of *Diapensia* and *Pyxidanthera.*

There is a genus, however, which accords with these in the whole general structure of the flower, and even in that of the filament and anther. This is *Shortia*, Torr. & Gray, published, upon most imperfect characters, at the close of an article of mine in the American Journal of Science and Arts, vol. 42, in the year 1841, two years earlier, apparently, than the fully characterized *Schizocodon* of Siebold and Zuccarini. The history of this genus, and of the identification of the almost unknown Alleghanian plant with that of Japan, is given in the following note,*

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* "At the end of the separate herbarium of Michaux, in the museum of the *Jardin des Plantes*, Paris, is preserved a specimen, ticketed, 'Hautes montagnes de Carolinie, an Pyrola spec.? an genus novum?' The scapes bear the dehiscent capsule, tipped with a style, and surrounded by the sepals; the corolla and stamens are absent. A sketch of the specimen, a leaf, and the summit of one of the scapes were obligingly presented to me by Professor Decaisne. With more zeal than judgment, I drew up the characters from this unique and incomplete specimen, and in this Journal for January, 1841, in a note to an account of a botanical excursion to the mountains of North Carolina, I published the plant under the name of *Shortia galacifolia*, Torr. & Gray. Contrary to my hopes and expectations, the plant has not yet turned up in its native haunts. The late Dr. Short, who has since gone to his rest, deserved better commemoration at our hands than this empty name of a most obscure plant. Indeed, our botanists, applying the old law maxim, *De non apparentibus et de non existentibus eadem est ratio,* are not unreasonably doubting if there ever was any such plant. Some lucky botanist will probably rediscover it in the region around the Black Mountains. What I have now to announce is, that the genus is found, and probably the very species, in a widely distant region indeed, but just where, after all we have been learning, it was not unnatural to expect it.

"In the year 1843, if I mistake not (I cannot at this moment ascertain the exact which was published in the Journal above mentioned, in the year 1867.

Finally *Galax* of Linnæus, — a genus of undetermined affinity, — as I now perceive, has its floral peculiarities and its relationship explained upon comparison with *Shortia* or *Schizocodon*. Its corolla (still somewhat gamopetalous, as Baillon remarks in Adansonia, 1, p. 196) is deeply parted; and the stamens with the interposed squamulæ, or sterile series of stamens, are connate into a tube, which not a little resembles the corolla of *Diapensia*, the fertile stamens occupying the sinuses of its petaloid divisions instead of those of the corolla. The style also is short, and there is no persistent columella in the axis of the capsule. *Galax* has been referred to *Pyrolaceæ;* but the points of resemblance are few, and the differences many and great, in corolla, andrœcium, style, seeds, &c.

If, then, these two outlying genera are truly related to *Diapensia*, as I suppose them to be, the group which they compose will hardly be referred to *Ericaceæ*. As a distinct small order, *Galax* included, the name *Diapensiaceæ* should be preferred to *Galacineæ*. For Don's order *Galacineæ*, though the earlier in date, was a thoroughly heterogeneous assemblage.

The diagnoses of the genera here brought together are as follows: —

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date, none being given in the separate issue), the late Professor Zuccarini published a plant from the mountains of Japan under the name of *Schizocodon soldanelloides;* and Dr. Maximowicz last year added two other species, *S. ilicifolius*, which he thinks too closely resembles the original species, and *S. uniflorus*. Of the latter, as well as of *S. soldanelloides*, Dr. Maximowicz has obligingly supplied me with specimens. *S. uniflorus* appears to differ (and perhaps too little) from the original species chiefly in the single-flowered scape, broader bracts, broader and more numerously-nerved sepals, and more slender style. Of this as of *Shortia galacifolia*, the corolla and stamens are unknown. Until these parts are found, and prove to be different, I may venture to assume that the two are identical!

"Dr. Maximowicz, the latest and best botanical explorer of Japan and the adjacent regions northward, and whose excellent specimens have been liberally supplied to some of the principal herbaria of this country (where they are most interesting), is sedulously engaged upon a *Flora Japonica*. It should be left for him to decide which generic name should be adopted, the earlier and incomplete or the later and complete one.

"As to the affinities of the genus, I had thought mostly of *Galax*, itself of undetected relationship. The fringed Soldanella-like corolla and the similar foliage are unaccompanied by any other structural resemblances. Zuccarini simply refers the genus to *Polemoniaceæ;* and I will add that its nearest known relative is *Diapensia*."

ORD. DIAPENSIACEÆ, Lindl. (auctus.) Herbæ perennes, nunc suffruticuloso-perennantes, alternifoliæ, pentameræ, gamopetalæ; calyce 5-sepalo persistente corollaque hypogynis æstivatione quincuncialibus; staminibus corollæ adnatis laciniis ejusdem alternis, filamentis sæpius dilatatis, antheræ loculis horizontaliter vel oblique bivalvibus; polline simplici; disco plane nullo; ovario (ima basi lata cum calycis fundo levissime concreta) 3-(raro 4-) loculari; stylo unico; stigmate subtrilobo nudo; ovulis indefinite numerosis in placentis axilibus anatropis vel amphitropis; capsula loculicida; seminum testa reticulata nucleo conformi vel relaxata; embryone parvo tereti in albumine carnoso, cotyledonibus brevissimis.

TRIBUS I. DIAPENSIEÆ. — Filamenta petaloideo-dilatata, corollæ campanulatæ usque ad sinus adnata; sterilia nulla: antheræ biloculares. Placentæ crassæ columellæ persistenti adnatæ. — Plantæ suffruticuloso-cæspitantes, depressæ, sempervirentes, foliosissimæ; foliis parvis sessilibus enervibus integerrimis; floribus terminalibus solitariis.

1. PYXIDANTHERA, Michx. Calyx pluribracteatus. Antheræ loculi rima transversa bivalves, valvula inferiore cuspide appendiculata. Ovula in loculis plurima, amphitropa. Semina subglobosa, testa nucleo conformi. — Laxe repenti-cæspitans, flore inter folia rosulata sessili. — P. BARBULATA, Michx. Fl. 1, t. 17; Gray, Bot. Text Book, ed. 3, cum ic. xyl.; Lindl. Veg. Kingd. p. 606, cum ic. xyl.; Bot. Mag. t. 4592.

2. DIAPENSIA, L. Calyx 2–3-bracteatus. Antheræ muticæ loculi basi divergentes obliqui, rima descendente bivalves. Ovula in loculis numerosissima, anatropa. Semina subcubica, testa nucleo subconformi. — Pulvinato-cæspitantes, pedunculo saltem fructifero evoluto scapiformi. — D. LAPPONICA, L. (Decaisne & LeMaout. Trait. Bot. p. 235, cum ic. xyl. opt.) 2 D. HIMALAICA, Hook. f. Kew Jour. Bot. p. 372, t. 12.

TRIBUS II. GALACINEÆ. — Filamenta fertilia (complanata) cum totidem sterilibus vel squamulis alternis connata, vel discreta. Antheræ muticæ. Ovula anatropa. Semina sursum imbricata, testa relaxata, ad chalazam producta. — Herbæ acaules; foliis longe petiolatis rotundato-cordatis plus minus dentatis venosis perennantibus scapisque elongatis racemoso-uni–multifloris e rhizomatibus repentibus ortis.

3. SHORTIA, Torr. & Gray, 1841, (*Schizocodon*, Sieb. & Zucc. 1843.) Corolla infundibuliformi-campanulata, 5-loba; lobis fimbriato-multifidis.

Stamina discreta: filamenta fertilia usque ad faucem (sub sinubus) adnata: antheræ biloculares fere *Diapensiæ*, loculis connectivum marginantibus demum transversis. Squamulæ seu filamenta sterilia oppositipetala corollæ supra basim inserta, lineares. Stylus elongatus. Semina in placentis amplis columellæ persistenti adnatis numerosissima, sursum imbricata, oblique ovata, ad chalazam obtuse apiculata. — Folia repando-dentata, sæpius retusa, laxe venosa. Scapus uni–pauciflorus, superne squamoso-bracteatus, bracteis sepalisque demum chartaceis nervosis. — S. GALACIFOLIA, Torr. & Gray in Sill. Jour. l. c. — *Schizocodon soldanelloides*, Sieb. & Zucc., Act. Acad. Monac. 1843, t. 2, f. 1, *S. ilicifolius* et *S. uniflorus*, Maxim. aut species peraffines, aut in unicam conjungendæ?

4. GALAX, L. Corolla 5-partita, lobis obovato-spathulatis integerrimis. Stamina 5 fertilia cum sterilibus squamulisve in tubum basi corollæ adnatum apice 10-dentatum connata, dentibus subspathulatis, fertilibus quam sterilia brevioribus et apice latioribus antheram unilocularem tranversim bivalvem introrsum adnatam gerentibus. Stylus brevissimus. Placentæ ab axi sæpius tripartibili dissepimentis adnata secedentes. Semina plurima, angusta, sursum longe attenuata. — Folia crebre dentata, reticulata. Scapus nudus, racemum multi- et parviflorum gerens; bracteis minimis fere obsoletis. — G. APHYLLA, Linn. *Erythrorhiza rotundifolia*, Michx. Fl. 2, p. 35, t. 36.

2. *Revision of the North American Polemoniaceæ.* By ASA GRAY.

I. *Stamina inæqualiter inserta.*

1. PHLOX. Corolla hypocraterimorpha. Filamenta brevia, inclusa. Ovula in loculis 1–5. Semina sub aqua immutata, tegumento simplici albumini adhærente. — Folia integerrima, saltem inferiora opposita.

2. COLLOMIA. Corolla aut hypocraterimorpha aut infundibuliformis. Filamenta gracilia, sæpius exserta. Ovula in loculis solitaria, pauca, vel plurima. Semina humefacta mucilaginosa spirillifera. — Folia omnia vel plera alterna, sæpius pinnatipartita vel incisa.

II. *Stamina æqualiter inserta. Semina humectata plerumque spirillifera vel mucilaginosa.*

3. GILIA. Corolla a hypocrateriformi ad subrotatam. Filamenta haud declinata inappendiculata. — Folia varia.

4. POLEMONIUM. Corolla ab infundibuliformi ad rotatam. Filamenta gracilia, plus minus declinata, basi piloso-appendiculata. Folia alterna, pinnatisecta.

These are the best diagnostic characters to be had for the Polemoniaceous genera with which we have here to do. One other, *Læselia*, is not unlikely to be found along our Mexican frontier. The genera at first sight would appear to be more obviously and strictly limited than they actually prove to be; and, except for certain connecting forms, their number might be properly increased by the severance of one polymorphous genus into several, which, for the want of a little extinction, just fail to establish their characters. These plants may also interest the philosophical botanist in another particular, namely, in what seems to be the indications of an incipient dimorphism, discernible in sundry species, but in none of them, perhaps, completely carried out into reciprocally long and short filaments and style. For instance, in some species of *Gilia*, section *Leptosiphon*, the style is long in some individuals and short in others, while the stamens are uniform; on the other hand, at least in one species of the section *Ipomopsis* the stamens are exserted in some individuals and included in others, with little or no obvious difference in the style. In view of these facts, we may suspect that the two sorts of style which Professor Thurber and Professor Torrey have detected in the genus *Phlox* (namely, that more than half the species have a long style, so that the stigmas are often exserted, while the rest have very short ones, bearing the stigmas low down in the tube of the corolla) are somehow of dimorphic nature. Yet it is only in *P. subulata* that I have seen both long and short styles; and here the short-styled plant has (irrespective of this character) been described as a distinct species (*P. nivalis*, *P. Hentzii*), and is apt to have a pair of ovules in each cell, while the long-styled *P. subulata* rarely shows more than one. Moreover, in the *Speciosa* group this character of the style really furnishes one of the most available specific distinctions. Whatever view be taken of it, the case may properly be compared with that of certain species of the generally dimorphic genus *Primula*, mentioned by Mr. Scott (in Jour. Linn. Soc. 8, p. 80), which, so far as known, are either long-styled or short-styled without their complementary fellow. Similarly the two species of *Gilia* composing the group which I have named *Giliandra* might be regarded as the long-stamened form, of which the short-stamened counterpart is unknown or non-existent. A state of things which, although singular, is intelligible upon the doctrine of the gradual evolution of specific and dimorphic differences.

1. PHLOX, L.

Corolla hypocraterimorpha, ore angusto. Stamina tubo valde inæqualiter inserta: filamenta brevissima vel brevia, inclusa. Stylus nunc elongatus, faucem adæquans vel superans, nunc brevissimus. Ovula in loculis 1, 2, rarissime 3–5. Semina sub aqua immutata, tegumento simplici albumini adhærente nec mucilagine nec spirillis prædito.— Herbæ vel suffruticuli Amer. Borealis, foliis integerrimis, caulinis sessilibus oppositis summisve alternis, corollæ æstivatione maxime convolutiva.

§ 1. *Latifoliæ*, *Perennes*, Americæ Boreali-Orientales, uniovulatæ.

* *Thyrsifloræ;* cymulis compactis in paniculam floribundam vel thyrsum digestis, pedicellis brevissimis; caule elato stricto; corollæ lobis integerrimis.

1. P. PANICULATA, L. *P. paniculata* (forma pubescens) & *P. acuminata*, Pursh, Benth. in DC. *P. undulata*, Ait. *P. Sickmanni*, Lehm. *P. scabra*, Sweet, Brit. Fl. Gard. t. 248. *P. cordata*, Ell.; Brit. Fl. Gard. n. ser. t. 13. *P. corymbosa*, Sweet, l. c. t. 114, a rough-pubescent form. *P. glandulosa*, Shuttleworth, coll. Rugel, pubescent form.

2. P. MACULATA, L., Jacq. Vind. t. 127. *P. pyramidalis*, Smith, Exot. 2, t. 87; Brit. Fl. Gard. t. 233; very floribund cultivated state. *P. odorata*, Sweet, Brit. Fl. Gard. t. 224. *P. reflexa*, id. t. 232 (hybrid). *P. penduliflora*, Sweet, l. c. n. ser. t. 46. *P. suaveolens*, Ait. Kew.; form with white flowers and stem often spotless, to which belong *P. tardiflora*, Penny ex Benth., and *P. longiflora*, Sweet, Brit. Fl. Gard. ser. t. 31.

* * *Corymbosæ;* cymulis corymbosis nunc simplicibus; caulibus erectis vel patentibus; corollæ lobis latis integerrimis vel obcordatis.

+ *Glaberrimæ*, nitidæ, erectæ vel adscendentes; calycis lobis latis; corollæ lobis rotundatis integerrimis. Rarius corymbo vel caule scabro-puberulo.

3. P. OVATA, L. Sp. ed. 1, p. 152. Caulibus e basi decumbente vel repente adscendentibus (subpedalibus); foliis ovatis nunc oblongo-lanceolatis summisve subcordatis, infimis in petiolum angustatis; calycis dentibus brevibus ovatis seu lato-lanceolatis acutis.— Bot. Mag. t. 528. *P. Carolina*, var. *ovata*, Benth. in DC. *P. latifolia*, Michx. Fl. 1, p. 143.— Var. elatior; foliis lato- seu ovato-lanceolatis, calycis denti-

bus acutatis. *P. Carolina*, L. Sp. ed. 2. *P. triflora*, Brit. Fl. Gard. t. 293. Open woods, &c., upper country of Alabama and Carolina along the Alleghanies to Huntingdon Co., Penn., Porter. — *P. ovata* is the earlier name (although rendered somewhat obscure by the char. "floribus solitariis," which was taken from Plukenet's figure), and is the more to be preferred as the original of *P. Carolina* is one of those forms which seem to pass gradually into *P. glaberrima*. The Carolinian specimens of "Gray and Carey," referred in the Prodromus to *P. glaberrima*, are clearly of the present species.

4. P. GLABERRIMA, L. Caulibus gracilibus erectis (1 – 2-pedalibus); foliis lineari- nunc oblongo-lanceolatis summisve anguste ovato-lanceolatis superne sensim angustatis acuminatis firmioribus subaveniis margine subrevolutis, pagina superiore nitida; calycis dentibus triangulari- seu lanceolato-subulatis acutissimis. — Brit. Fl. Gard. n. ser. t. 36. *P. glaberrima* & *P. Carolina* var. *nitida* & *puberula*, Benth. in DC. *P. triflora*, Michx.; forma corymbo ramosiore laxiore. *P. nitida*, Pursh. *P. suffruticosa*, Willd. Enum.; Bot. Reg. t. 68. *P. carnea*, Sims, Bot. Mag. t. 2155; Lodd. Bot. Cab. t. 711. *P. Carolina*, Walt.; Sims, Bot. Mag. t. 1344, var. caule scabro-puberula. *P. revoluta*, Aikin in Eaton Man. — Prairies and open grounds, Ohio and Wisconsin to Florida and Louisiana.

+ + *Pilosæ* seu *Glandulosæ;* caulibus floriferis erectis vel patentibus; calycis pl. m. pilosi sæpius viscidi dentibus elongatis angustis seu angustissimis; corollæ lobis nunc retusis vel obcordatis.

++ Estolonosæ.

5. P. FLORIDANA, Benth. in DC. Caule stricto bipedali cum foliis lineari- seu oblongo-lanceolatis rigidulis pilosulo vel glabello apice cum corymbo glanduloso, calycis glandulosi dentibus lanceolato-setaceis; corollæ lobis obovatis integerrimis. — Chapm. Fl. p. 339. *P. Carolina*, Sweet, Brit. Fl. Gard. t. 190? — Dry open woods, Florida, Chapman, Rugel, &c. Distinguished from *P. glaberrima* by the much longer and narrower teeth of the glandular-pubescent calyx.

6. P. PILOSA, L. Caule erecto gracili (1 – 2-pedali) cum foliis lanceolatis linearibusque (sæpius a basi sessili ad apicem sensim attenuatis) villoso piloso vel pubescente nunc glabrato; corymbo demum aperto; calycis aut hirto-villosi aut pubescens subviscidi dentibus elongato- vel tenuissime subulato-setaceis superne nunc aristiformibus; corollæ lobis obovatis integerrimis. — Bot. Mag. t. 1307; Lodd. Cab.

t. 1251. *P. aristata*, Michx.; Lodd. Cab. t. 1731; Torr. Fl. N. Y. 2, t. 80. — New Jersey to Saskatchawan, Florida, and Texas. Variable in foliage, pubescence, &c.

Var. DETONSA: forma gracillima, sæpius angustifolia, lævis, corymbo calyceque modice parumve pubescentibus. — *P. aristata*, Benth. pro parte. — Florida, Alabama, Louisiana, Texas.

7. P. AMŒNA, Sims. Pube molli rarius hirtella pl. m. villosa; caulibus adscendentibus simplicibus (6 – 15-pollicaribus); foliis erectiusculis oblongis lanceolatis seu lineari-lanceolatis acutiusculis obtusisve, summis corymbum compactum bracteantibus; calycis dentibus anguste subulatis acutissimis vix aristatis; corollæ lobis obovatis integerrimis raro emarginatis. — Bot. Mag. t. 1308. *P. pilosa*, Walt., Michx. &c. non L. *P. pilosa?* var. *Walteri*, Gray, Man. ed. 2. *P. Walteri*, Chapm. Fl. p. 338. *P. procumbens*, Gray, Man. ed. 5, vix Lehm. *P. involucrata*, Nutt. herb. — Barrens, dry hills, &c., Virginia and Kentucky to Florida. Some forms nearly approach *P. pilosa*, with which it has been confounded, especially when *P. aristata* has been regarded as distinct.

++ ++ Substoloniferæ, e basi caules steriles reptantes vel decumbentes proferentes: folia breviuscula lata.

8. P. DIVARICATA, L.; Bot. Mag. t. 163. *P. Canadensis*, Sweet, Brit. Fl. Gard. t. 221. Corollæ lobi obcordati vel cuneati emarginati, nunc, in Var. *Laphamii*, Wood. integerrimi. *P. glomerata*, Nutt. herb. *P. glutinosa*, Buckley in Sill. Journ. 45, p. 177, as to the specimens, but the char. "flowers bright red or scarlet," must belong to something else, perhaps to some confusion of memory.

9. P. REPTANS, Michx.; Vent. Malm. t. 107. *P. stolonifera*, Sims, Bot. Mag. t. 563; Sweet, Brit. Fl. Gard. n. ser. t. 293. Both names date from the year 1803. *P. crassifolia*, Lodd. Bot. Cab. t. 1596. As Dr. Torrey has noted, this species has a long, often exserted style, the preceding a very short one, — characters we may suspect to be related to dimorphism; but if so the counterpart form has not been observed.

* * * *Sparsifloræ*, linearifoliæ, humiles, diffusæ; corollæ pallide violaceæ lobis cuneatis in segmenta angusta (linearia seu oblonga) bifidis.

10. P. BIFIDA, Beck.; Gray, Man. Pubescens; foliis nunc glabratis; corollæ lobis ultra vel ad medium usque in segmenta sublinearia bifidis. — Prairies of Illinois and Missouri; in spring.

11. P. STELLARIA, n. sp. Glaberrima, cæspitosa, basi subperennante; foliis angusto-linearibus rigidulis, superioribus basi parum ciliatis; pedunculis plerumque unifloris elongatis; corollæ "pallide cœruleæ nunc fere albæ" lobis apice in segmenta brevi-oblonga bifidis. — "Cliffs of Kentucky River (probably above Lexington), in the fissures of the most precipitous rocks," found only by the late Dr. Short, May 1, 1829. The station should be rediscovered. Flowers as large as those of the foregoing species. Named from the resemblance to a *Stellaria* both in foliage and blossoms.

§ 2. *Subulatæ, Suffrutriculoso-perennantes, Cis-Missisippianæ,* sempervirentes, uni-biovulatæ; foliis fasciculatis; corollæ lobis tantum obcordatis.

(P. PROCUMBENS, Lehm. Ind. Sem. Hamb. 1828; Sweet, Brit. Fl. Gard. n. ser. t. 7 — referred by Bentham to *P. subulata* var. *latifolia,* — in some specimens nearly approaches *P. subulata,* in others is more like *P. amœna,* for which in Manual, ed. 5, I mistook it. It is unknown as an indigenous plant, and is probably a hybrid of the two species above mentioned.)

12. P. SUBULATA, L. *P. subulata* & *P. setacea,* L. Chiefly with long style and solitary ovules. — *P. nivalis,* Lodd. Bot. Cab. t. 780; Sweet, Brit. Fl. Gard. t. 185; form with short style, ovules commonly, but not always, in pairs (rarely 3) in each cell, and corolla white. *P. aristata,* Lodd. l. c. t. 1731. *P. Hentzii,* Nutt., with white corolla, its lobes entire or nearly so, short style, and, in Nuttall's specimens, solitary ovules. — Dry open ground, New York to Michigan and Florida.

§ 3. *Occidentales* (transmontanæ et montanæ), suffrutescentes vel suffruticulosæ, raro a basi usque herbaceæ, uni-triovulatæ; ramis uni-paucifloris; foliis plerumque angustis vel parvis margine sæpius pl. m. cartilagineo-incrassatis. Species difficillimæ ut videtur inosculantes.

* *Pulvinato-cæspitosæ,* suffruticuloso-perennantes, sempervirentes; foliis brevibus nunc minimis usque ad flores solitarios (sessiles, in postrema nunc brevi-pedunculatos) confertis imbricatisve ac fasciculatis basibus scarioso-connatis, vetustis marcescentibus; ovulis solitariis. Species a minimis imbricatifoliis ad laxiores patentifolias ordinatæ.

+- Folia saltem ad margines pilis arachnoideis instructa,

++ Brevissima, latiuscula vel squamiformia, imbricata, mollia, tantum mucronata. Plantæ pulvinatæ musciformes; corollæ lobi integerrimi.

13. P. Richardsonii, Hook. Fl. 2, p. 73, t. 160. Laxius pulvinata; foliis oblongo-lanceolatis (lin. 3 longis) parcius lanigeris marginibus incrassatis mox reflexis imbricatis, vetustis laxe patentibus; corollæ "læte lilacinæ," tubo calycem dimidio excedente, lobis late cuneato-obovatis lin. 3 longis. — Arctic sea-shore.

14. P. bryoides, Nutt. Pl. Gamb. p. 153. Densius pulvinata, minima, facie *Selaginellam rupestrem* referens, copiose mollissime lanata; ramulis discretis; foliis arcte quadrifariam imbricatis squamæformibus ovato- seu triangulari-lanceolatis (sesquilineam longis) etiam marcescentibus creberrime appressis, marginibus subinflexis; corollæ tubo calycem modice superante, lobis cuneatis sesquilineam longis. — Dividing ridge of the Rocky Mountains (about lat. 42°), Nuttall.

15. P. muscoides, Nutt. Jour. Acad. Philad. 7, p. 42, t. 6, p. 2 Præcedenti similis, *Bryum* aliquid canescens referens; ramis brevibus confertissimis; foliis minus stricte quadrifariis parcius lanatis ovato-lanceolatis parum mucronulatis (sesquilineam longis); corollæ tubo calycem haud superante. — Rocky Mountains at the sources of the Missouri River, Wyeth.

++ ++ Folia rigidiora, subulata, subacerosa (lin. 3 – 4 longa), minus appresso-imbricata. Plantæ late cæspitantes, corollis ut videtur albis.

16. P. Hoodii, Richards. Appx. t. 28. Parcius lanata, glabrata; foliis erectis; corollæ tubo calycem haud superante, lobis obovatis integris, 2 – 2½ lin. longis. — Through the Saskatchawan region from lat. 54° to the Rocky Mountains about lat. 44°.

17. P. canescens, Torr. & Gray, Pacif. R. R. 2, p. 8, t. 6. Magis lanata, canescens; foliis e basi appressa mox patentibus vel subsquarroso-recurvis; corollæ tubo calycem pl. m. sæpius dimidio superante, lobis obovatis integris vel emarginatis lin. 3 – 4 longis. — Rocky Mountains of Colorado and throughout Utah to New Mexico and the Sierra Nevada.

+ + Folia rigidiora marginibus basi saltem hirsuto- vel hirtello-ciliata, nunc nuda.

18. P. cæspitosa, Nutt. l. c. t. 6, f. 1. Dense seu laxiuscule cæspitosa; foliis rigidis lineari-subulatis seu oblongo-linearibus (lin. 4 – 6

longis) crebris vel creberrimis hispido- vel hirtello-ciliatis cæterum glabris vel parce hirtello-glandulosis; corollæ tubo calycem parum superante, lobis obovatis integris lin. 3 longis. — Var. RIGIDA: depressa; foliis aceroso-subulatis demum recurvo-patentibus parce glanduloso-hirtellis. *P. rigida*, Benth. in DC. — Var. CONDENSATA: pulvinato-cæspitosa; foliis brevibus (lin. 2 – 3 longis) creberrime arrecto-imbricatis. *P. Hoodii*, var. Gray, Enum. Pl. Parry. (298) in Sill. Jour. — Rocky Mountains, Colorado to Montana, Oregon, and high Sierra Nevada.

19. P. DOUGLASII, Hook. Cæspitoso-ramosissima, pubescens vel glabella; foliis rigidulis acerosis sæpius patentibus minus crebris, marginibus aut nudis aut basi hirsutiusculo-ciliatis; flore subsessili; corollæ (purpureæ seu albæ) tubo calycem pl. m. superante, lobis obovatis integris lin. 3 longis. — Hook. Fl. 2, p. 73, t. 158. — Var. DIFFUSA: ramis procumbentibus foliisque laxioribus patentibus minus rigidis. — Var. LONGIFOLIA: ramis sæpius erectis e rhizomate prostrato; foliis angustissime vel aceroso-linearibus lin. 5 – 8 longis minus fasciculatis. *P. Hoodii*, Torr. Ann. Lyc. 2, p. 220, & in Frem. Rep. *P. Sibirica*, Hook. Kew Jour. Bot. 3, p. 290. — High plains and mountains, Montana, Colorado, and Utah, west to the Sierra Nevada and the Cascades; the var. diffusa on the Pacific slopes from the Yosemite to lat. 49°, the var. longifolia east of the Rocky Mountains and in Utah. This makes nearly a transition to *P. longifolia*, Nutt. One of Nuttall's specimens of this form, named by him *P. andicola*, exhibits, along with flowers having the usual inequality in the stamens, one or two with stamens perfectly equally inserted in the throat of the corolla!

* * *Speciosæ*, basi tantum lignosæ nunc herbaceæ, multicipites vel laxe cæspitantes; foliis vulgo longioribus linearibus lanceolatisve raro subovatis laxis nec parumve fasciculatis; floribus solitariis vel subcymosis longius pedunculatis!

+ *Longistylæ*.*

++ *Frigidæ*; foliis caulibusque laxe cæspitantibus subflaccidis.

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* The character of the style — in this division elongated and frequently equalling the tube of the corolla, in the other hardly exceeding or even equalling the ovary and the stigmas — may be suspected to be dimorphic, as I have supposed to be the case in *P. subulata*. But in this group there is no evidence of it; and the character is most convenient and useful in the arrangement of these otherwise almost inextricable Western Phloxes.

20. P. Sibirica, L. Bi–quadripollicaris, piloso-pubescens; foliis angusto-linearibus margine sæpius villosulis; pedunculis nudis unifloris; corollæ tubo lobis suis obcordatis retusisve calycique æquilongo vel paullo longiore; ovulis in loculis binis. (Gmel. Fl. Sib. 4, t. 46, f. 2.) Trautv. Imag. Fl. Russ. t. 24. — Kotzebue's Sound and E. Siberia.

++ ++ *Temperatæ;* foliis cum caulibus basi suffruticosis erectis vel adsurgentibus rigidulis: corolla alba seu rosea, tubo lobos calycis angusto-subulatos superante.

a. Stenophyllæ: calycis tubus ad basim usque membranulis intercostalibus scariosis mox replicatis sæpius angulatus.

21. P. linearifolia. Glaberrima vel superne nunc hirtello-pubens, spithamæa ad pedalem, corymboso-floribunda; foliis angustissime linearibus (1–2-pollicaribus); calycis tubo e basi lata inter costas eximie membranaceo-angulata quasi pyramidato, dentibus aceroso-subulatis; corollæ tubo calycem paullo excedente, lobis obovato-cuneatis integris raro retusis; ovulis in loculis binis. — *P. speciosa* var. *linearifolia,* Hook. Kew Jour. Bot. 3, p. 289, pro parte. *P. speciosa,* Lindl. Bot. Reg. t. 1351; Benth. in DC., non Pursh. — Interior plains of the Columbia River and its tributaries, the Kooskooskie, Clearwater, &c., Douglas, Spalding, Geyer, Burke, Lyall.

22. P. longifolia, Nutt. Jour. Acad. Philad. 7, p. 41. Glabra vel pubescens, circa spithamæa; foliis angustissime vel angusto-linearibus (1–2½-pollicaribus) quandoque lanceolatis; corollæ lobis obovato- seu oblongo-cuneatis integris retusisve; ovulis in loculis fere semper solitariis. — *P. speciosa, β.* Hook. Fl. 2, p. 72, &c. *P. humilis,* Dougl. in Benth. l. c. — a small form, with shorter peduncles, sometimes apparently passing into *P. Douglasii,* var. *longifolia.* — Var. Stansburyi: validior; pube ramorum calycisque pl. m. glandulosa seu viscosa, foliis vulgo latioribus; corollæ tubo calyce sæpius duplo longiore, lobis apice nunc emarginatis nunc erosis; loculis 1–2 ovarii quandoque biovulatis. *P. speciosa,* var.? *Stansburyi,* Torr. Bot. Mex. Bound. p. 145. — Forma brevifolia, nana; foliis nunc angusto- nunc oblongo-lanceolatis semipollicaribus. — Rocky Mountains to the Cascades and Sierra Nevada, and from Washington Territory to Nevada and Utah. The var. Stansburyi and its short-leaved form chiefly in the southern districts, and extending into New Mexico and Arizona. This also has usually uniovulate cells, but with one or two (rarely perhaps all three) cells sometimes 2-ovuled.

b. Brachyphyllæ: calyx sinubus scariosis vix replicatis subteres.

23. P. ADSURGENS, Torr. in herb. Præter inflorescentiam glabra; caulibus diffusis adscendentibus gracilibus (subpedalibus); foliis ovatis seu ovato-lanceolatis acutis semipollicaribus plerumque internodiis multo brevioribus; pedunculis subcymosis calyceque glanduloso-pubescentibus; corollæ tubo calyce subduplo longiore, lobis obovatis integris; ovarii loculis uniovulatis. — "Cañon Pass, Oregon," Prof. A. Wood. — Tube of the corolla nearly an inch, its lobes five lines, long. Style exserted. — Peculiar as this appears, some of the short-leaved forms referred to the preceding species make an approach to it.

+- +- *Brevistylæ*, nempe stylo quam stigmata ovariumque vulgo breviore. Calyx membranulis intercostalibus haud replicatis cylindraceus, lobis subulatis.

24. P. SPECIOSA, Pursh. Subviscoso-puberula vel glabrata, 1–4-pedalis; ramis e basi lignosa decumbente adsurgentibus; foliis lanceolatis seu linearibus (sesqui–bipollicaribus), supremis basi plerumque dilatatis; floribus corymbosis; corollæ roseæ seu albæ tubo calycem parum superante, lobis obcordatis; ovulis in loculis solitariis. Pursh! Fl. 1, p. 149. *P. speciosa*, var. *latifolia*, Hook. Kew Jour. 3, p. 289. *P. occidentalis*, Durand in Pacif. R. R. 4, p. 125, forma latifolia. — Interior plain of the Columbia, Washington Territory, to the foot hills of the Sierra Nevada, California. — Determined from an original specimen of herb. Lamb., now of herb. Kew, collected on the "Plains of the Columbia, about 4 feet high, May 7, 1806," Lewis and Clarke: although injured, the obcordate lobes of the corolla are conspicuous. Corolla in the larger specimens an inch or even more in diameter.

Var. SABINI: corollæ lobis obovatis basi cuneatis integerrimis vel retusis. — *P. speciosa*, var. *elatior*, Hook. Fl. l. c. *P. Sabini*, Dougl. in Hook. & Benth. l. c. — Spokan River, Washington Territory.

Var. WOODHOUSII: nana; foliis linearibus basi nec dilatatis; floribus dimidio minoribus; corollæ lobis cuneatis obcordatis. — *P. Woodhousii*, Torr. ined. *P. nana*, Torr. Sitgreaves Rep. p. 165, non Nutt. — Arizona (lat. 35°, long. 112° 20′), Woodhouse in Sitgreaves Exped.

25. P. NANA, Nutt. Pl. Gamb. l. c. Glanduloso-pubescens vel hirtella, nunc glabrata, e basi frutescente patenti-ramosa, spithamæa ad pedalem; foliis linearibus, ramealibus sæpe alternis; floribus sparsis;

corollæ "rubræ" roseæ vel "albæ" tubo calycem paullo superante, lobis amplis latissime cuneato-obovatis integris nunc erosulis; ovulis in loculis 3, rarius binis. *P. triovulata*, Thurber in Bot. Mex. Bound. p. 145. — Var. GLABELLA: ramis simplicioribus erectis; foliis angustioribus. — New Mexico (near Santa Fé, &c.) and adjacent borders of Texas and Colorado. (No. 1654, Wright, may be added to the numbers cited in Mex. Bound. Survey; this and 504 are of the smoothish and more erect variety.) Limb of the corolla commonly an inch, sometimes an inch and a quarter in diameter: apparently a showy species. No state of the plant seen can justly be described as "canescently pubescent."

§ 4. *Annuæ, Texenses,* laxe ramosæ, plus minus viscoso-pilosæ (pilis multiarticulatis plerumque glandula parva terminatis); foliis latiusculis, superioribus alternis; calycis (fructiferi fere ad basim usque fissi) lobis setaceo-apiculatis mox recurvis vel patentibus; stylo stigmatibus breviore; seminibus subalato-angulatis.

* *Uniovulatæ,* corymbifloræ.

26. P. DRUMMONDII, Hook. Bot. Mag. t. 3441; Bot. Reg. t. 1949, Brit. Fl. Gard. ser. 2, t. 316 (forma parviflora). Folia sæpius lanceolata seu oblonga, superiora basi subcordata semiamplexicaulia.

Var. VILLOSISSIMA: pilis viscosis longis crebris; foliis angusto-lanceolatis; floribus magnis subsparsis. — Texas, in the pebbly bed of the Nueces, Wright, no. 1656.

Var. TENUIS: spithamæa; pube breviore parciore in foliis plerumque linearibus basi nunquam dilatatis nunc evanida; cyma laxiflora; floribus parvulis; corollæ lobis obovato-cuneatis lin. 2–4 longis. — Eastern Texas, Berlandier (1822, &c.), Drummond (coll. 3, 312), Lindheimer (424), Wright.

* * *Pluri*-(4–5-) *ovulatæ,* sparsifloræ.

27. P. RŒMERIANA, Scheele in Linnæa, 21, p. 752. Humilis, e basi laxe ramosa, præter margines foliorum calycisque tubum hirsutos subglabra; foliis lanceolatis oblongis imisve spathulatis, caulinis plerumque alternis; corolla rosea ampla, tubo glabro calycis lobos lineares tantum patentes subæquante lobis suis latissime obovatis (lin. 6–9 longis) breviore; capsulæ loculis oligospermis. *P. macrantha,* Buckley in Proceed. Acad. Philad. 1862, p. 5. — Not rare in the central district of Texas, Lindheimer, Rœmer, Wright, Buckley, Thurber, &c.

In describing this remarkable species, neither Scheele nor Buckley mentions the annual root, nor the prevailingly alternate leaves, nor the numerous ovules; indeed, poor Scheele gives the character "loculis uniovulatis." Dr. Engelman has proposed to transfer this species to *Gilia;* but the number of ovules in these genera proves to be a wholly secondary character.

2. COLLOMIA, Nutt. mutatis mutandis.

Corolla tubuloso-infundibuliformis vel hypocraterimorpha, fauce sæpius sensim plus minus ampliata. Stamina fauci vel infra faucem *inæqualiter* inserta: filamenta gracilia, sæpe exserta. Ovula in loculis solitaria, pauca, vel plurima. Semina humefacta e tegumento simplici tubulos mucilaginosos plerumque spirilliferos creberrime protrudentia. — Herbæ annuæ, raro biennes, foliis alternis imisve oppositis sæpius incisis nunc pinnatisectis.

Of the two characters which in the Prodromus distinguish *Collomia* from *Gilia*, namely, the unequally inserted stamens and the solitary ovules, Bentham gave evident preference to the latter, as appears from his removal of *C. heterophylla* to *Navarretia;* yet uniovulate species are left in *Gilia*. As it is now abundantly evident that none of our Polemoniaceous genera can be made to rest upon the number of ovules, I rely so completely upon the remaining character that I propose to remove from *Gilia* to *Collomia* two multiovulate species, in which I detect a striking inequality in the insertion of the stamens, and even to add an unpublished species having a much-dilated throat to the corolla.

Collomia nudicaulis, Hook. & Arn., has very many ovules, and belongs to the *Leptosiphon* section of *Gilia*, although peculiar in its sessile anthers and entire leaves.

The "mucilage" so copiously developed on the surface of the seed when immersed in water, and which gave name to the genus, consists of innumerable and most delicate diaphanous tubes, which lengthen wonderfully when wetted. The spiral thread which they contain (on which account they were confounded with "spiral vessels," and which uncoils as the tube softens or dissolves into jelly) is wanting in one species, namely, *C. gracilis*. In this and in the several following species, the mucilage cells are beneath a more or less evident pellicle or epidermis, composed of fragile tabular cells, which are thrown off when the former develop and protrude under moisture. But this pellicle is not obvious in the typical species.

§ 1. EUCOLLOMIA. Ovula in loculis solitaria, in spec. ultima 2–3. Annuæ, plus minus viscoso-pubescentes. — *Collomia*, cum *Navarretia heterophylla*, Benth. in Prodr.

* *Genuinæ*, simplici- et sessilifoliæ, sæpius confertifloræ, calyce obconico, corolla angusta. Semina maxime spirillifera.

+ Flores capitato-glomerati, folioso-bracteati, infimi in dichotomiis nunc subsolitarii.

1. C. COCCINEA, Lehm., Benth. l. c. — Chili.

2. C. GRANDIFLORA, Dougl. — West of the Rocky Mountains. — Var. TENUIFLORA, Benth. in DC.: a form with a more slender corolla. Var. CRYPTANTHA, Regel: perhaps a sport of cultivation.

3. C. LINEARIS, Nutt. — Both sides of the Rocky Mountains, north to Mackenzie River: also on the shore of New Brunswick, Fowler, perhaps a waif.

Var. SUBULATA: spithamæa, divergenti-ramosa; foliis lineari-lanceolatis seu linearibus utrinque attenuatis; glomerulis laxiusculis alaribus imis paucifloris nunc unifloris; calycis lobis e basi lata attenuato-subulatis tubo parum longioribus. *C. tinctoria*, Kellogg in Proc. Acad. Calif. 3, p. 17, t. 2, ex char. — E. California and W. Nevada, Lobb (1857), Dorr, Stretch; Klamath Valley, Oregon, Kronkrite. And S. Watson collected in Nevada a form so intermediate as to forbid our regarding it as a distinct species.

++ Flores omnes dissiti, in dichotomiis solitarii.

4. C. TENELLA, n. sp. Viscoso-puberula, e radice exili 3–4-pollicaris, pusilla, laxe ramosa; foliis linearibus uniformibus integerrimis obtusiusculis basi longius attenuatis, imis oppositis; floribus subsessilibus; calycis lobis triangulatis acutis tubo brevioribus corolla angusta fere hypocraterimorpha dimidio brevioribus. — Nevada, in Wasatch Mountains about Parley's Park, Watson in King's expedition. — Flowering almost from the base. Calyx broadly obconical, barely two lines long; the corolla at length four lines. Leaves about an inch long, all scattered.

* * *Intermediæ*, cymoso-sparsifloræ; foliis sessilibus integerrimis, inferioribus sæpius oppositis; calyce fere 5-partito basi obtusissimo. Semina sub aqua mucilaginosa sine spirillis.

5. C. GRACILIS, Dougl. Occurs under very various forms in the western parts of North and South America. *C. micrantha*, Kellogg, l. c. fig. 3, evidently belongs here.

* * * *Giliæformes;* foliis pinnatisectis incisis vel 3 – 5-partitis, inferioribus petiolatis alternis; calyce basi obtuso; corolla fere hypocraterimorpha. Semina sub epidermide tenerrima spirillifera.

6. C. GILIOIDES, Benth. Flores subsparsi, staminibus insertione minus inæqualibus. — Var. GLUTINOSA. Forma corolla sæpius longiore, staminibus magis inæqualiter insertis; ovulis raro binis. *C. glutinosa*, Benth. *Gilia* (*Allophyllum*) *divariata*, Nutt. Pl. Gamb. p. 155, a slender form. — These appear to be of one species. The protrusion or inclusion of the stamens is probably an individual character of incipient dimorphism, as is evidently the case in the next. — California.

7. C. HETEROPHYLLA, Hook. *Navarretia heterophylla*, Benth., cum syn. Flores pl. m. glomerati; staminibus valde inæqualibus; ovulis in loculis 2 – 3. — British Columbia to California.

§ 2. PHLOGANTHEA. Ovula in loculis plurima (6 – 12). Filamenta quandoque declinata, tum inæqualia tum inæqualiter inserta. Folia vel segmenta tenui-linearia integerrima. Thyrsifloræ vel sparsifloræ, nec viscidæ. Semina ut in prioribus spirillifera.

* Folia caulina semel pinnati-3 – 7-partita; corolla ad faucem usque angusta.

8. C. CAVANILLESIANA, Don. Biennis vel basi indurata perennis? pubescens vel puberula; caulibus ramisve virgatis foliosis; thyrso angusto sæpius racemiformi, pedunculis brevibus glomeruli-floris; corolla alba "luteo-albicante" Cav. seu purpurascente (semipollicari), tubo calyce 2 – 3-plo longiore superne paullo sensim ampliato, lobis oblongis; filamentis fauci plerumque subobliquo insertis; antheris rotundis; ovulis in loculis 5 – 7. *Phlox pinnata*, Cav. Ic. 6, p. 17, t. 528. *Cantua glomeriflora*, Juss. Ann. Mus. 2, p. 119. *Gilia glomeriflora*, Benth. l. c. G. *multiflora*, Nutt. pl. Gamb. — Borders of W. Texas, New Mexico, Arizona, and adjacent parts of Mexico. Doubtless (as Bentham suspects) not from Buenos Ayres, and hardly yellow-flowered, although Galeotti's specimens seem to be so, and are noted on the ticket: "fl. orangées." And in our district it is probably more than a biennial. G. Don having referred the species to *Collomia*, it may retain the new specific name imposed by him: he supposed the ovules were solitary, and did not notice the obvious inequality in the insertion of the stamens.

9. C. THURBERI, n. sp. Biennis? puberula; caulibus e basi indurata virgatis sesquipedalibus crebre foliosis; inflorescentia spicato-thyrsiformi fere præcedentis; pedunculis pedicellisque brevissimis; calycis lobis tubo subæquilongis; corolla "cærulea vel lilacina" hypocraterimorpha, tubo ultrapollicari sursum sensim parum ampliato lobis orbiculatis calyceque 3–4-plo longioribus; filamentis fauci rectæ insertis; antheris brevi-oblongis; ovulis in loculis 8–9. *Gilia Thurberi*, Torr. in herb.— New Mexico, near the copper mines, &c., Thurber. Intermediate between the foregoing and the following, with far larger flowers than the former; from their size and abundance apparently very handsome.

10. C. LONGIFLORA. Annua, glaberrima; foliorum segmentis angustissimis elongatis; caule (subpedali ad bipedalem) paniculato-ramoso laxifloro; pedunculis unifloris sæpissime gracilibus subcorymbosis; calycis lobis tubo brevioribus; corolla alba hypocraterimorpha, tubo longissimo (sæpe sesquipollicari), lobis orbiculatis ovatisve (nunc acumine apiculatis); filamentis intra tubum superne haud ampliatum nunc 2–3 ad faucem valde inæqualiter insertis; antheris oblongis; ovulis in loculis 10–12. *Cantua longiflora*, Torr. Ann. Lyc. *Gilia longiflora*, Don, Benth., &c. — Nebraska to New Mexico, W. Texas, and Arizona; common in pine forests, &c.

* * Folia omnia integerrima: corolla infundibuliformis.

11. C. LEPTALEA, n. sp. Annua, glandulosa vel glaberrima; caule gracillimo (4–10-pollicari) effuse paniculato; foliis angusto-linearibus; floribus sparsis filiformi-pedicellatis; corolla alba vel purpurea, tubo tenui e calyce exserto in faucem latam lobis ovatis sublongiorem ampliato; filamentis valde inæqualiter insertis; antheris brevissimis; ovulis in loculis 6. — California, in the Sierra and foot hills, from Plumas to Mariposa County, Bridges, Newberry, Mrs. Davis, Torrey, Bolander, A. Wood; the latter collected a more glandular form, and states that the corolla is "scarlet." Calyx 1–2, corolla 5–7 lines long. Flowers very loosely panicled; pedicels naked, terminal and opposite the leaves, 3–12 lines long, almost capillary.

3. GILIA, Ruiz & Pav.

Corolla infundibuliformis, hypocraterimorpha, nunc fere campanulata vel rotata. Stamina fauci vel tubo nunc sinubus corollæ æqualiter inserta: filamenta sæpissime gracilia, haud declinata, basi fere semper nuda. Ovula in loculis plurima vel pauca, in nonnullis solitaria.

Semina humefacta plerumque (ut *Collomiæ*) mucilaginosa, in omnibus oppositifoliis palmatifidis nec spirillifera. Herbæ, paucæ suffrutices, habitu, variæ. — *Gilia* et *Navarretia*, Ruiz & Pav., Benth. in DC.

Thus regarded, *Gilia* is certainly a polymorphous as well as a large genus; but definite characters are vainly sought for dividing it and for keeping *Navarretia* separate. The most natural separation would seem to be into three genera, characterized mainly by the foliage: — namely, 1. *Gilia*, with alternate and pinnately cut or divided leaves; 2. *Leptodactylon*, frutescent plants, with nearly the corolla of *Phlox*, and alternate palmately parted leaves; and 3. *Leptosiphon*, annuals, with opposite and palmately divided (or entire) leaves. And to this the seeds in some sort answer, — those of the first being mostly mucilaginous and spirilliferous, as in *Collomia*, of the second (always?) unaltered in water, as in *Phlox*, one section of which it externally resembles in foliage; of the third, more or less mucilaginous, but destitute of spiricles; which is paralleled by the one *Collomia*, *C. gracilis*, that tends to have opposite leaves, — points worth noticing by those who accept the doctrine of the derivation of species. But Nuttall's *Siphonella* and a new opposite-leaved *Leptodactylon* nearly efface the distinctions between the latter and *Leptosiphon;* some species of the opposite and palmate series have the upper leaves prevailingly alternate; one of the alternate-leaved series has trisected leaves seemingly of the palmate sort; and a few scattered species of the same series have seeds which produce neither simple mucilaginous tubes nor spiricles when wet. Those of *G.* (*Ipomopsis*) *coronopifolia* differ in this way from those of the nearly related *G. aggregata*. Similarly *G.* (*Linanthus*) *dichotoma* has seeds with a loose arilliform external coat, under which are apparently no mucilage cells or tubuli, while these abound under the closer coat in the nearly related *G. Bigelovii*, as in the other species of that series. It is obviously impracticable, therefore, to restore any of those, at first apparently well-marked genera which Mr. Bentham proposed, and afterwards merged in *Gilia*. To complete our view of the genus I have included the few South American species.

SERIES I. *Palmati-* seu *Oppositifoliæ*, nempe foliis sessilibus palmatisectis (segmentis angustis integerrimis) in perpaucis integris, oppositis vel summis ramealibusque quandoque alternis, in *Leptodactylis* pleris alternis. Semina humefacta tegumento sæpius mucilaginoso sed nunquam spirillifero.

§ 1. DACTYLOPHYLLUM. Corolla campanulata, fere rotata, vel breviter infundibuliformis, lobis obovatis. Filamenta gracilia: antheræ ovales. Ovula in loculis plurima, rarius pauca. Annuæ, pusillæ vel tenues, sæpissime sparsifloræ.

* Flores in dichotomiis subpedicellati. Corolla campanulata, tubo proprio nullo, lobis integerrimis. Folia pleraque tripartita.

1. G. DEMISSA, n. sp. Divaricato-ramosissima, depressa, glabella; foliis rigidulis, segmentis acerosis; calyce fere 5-partito, segmentis inæqualibus lanceolato-subulatis marginibus scariosis, longioribus sæpe foliiformibus corollam albam medio 5-lobam adæquantibus; staminibus inclusis corollæ basi insertis; ovulis in loculis 7. — S. E. California and adjacent part of Arizona, Fremont; mouth of Diamond River, Newberry (*G., Dactylophyllum*, n. sp. in Ives Exped. p. 22); near Fort Mohave, Cooper. Plant 2 – 3 inches high. Flowers somewhat cymosely crowded, the upper internodes being short: pedicels at most a line long, often almost wanting. Corolla 3 lines long.

* * Flores sparsi tenuiter sæpius longissime pedicellati. Corolla aut breviter infundibuliformis aut fere rotata, lobis integerrimis. Folia 3 – 7-secta, superiora sæpius alterna, scabro-hispidula, hirsutula, vel fere glabra. *Gilia* sect. *Dactylophyllum*, Benth.

2. G. LINIFLORA, Benth. Folia *Spergulæ* facie; pedicellis capillaribus; corolla (alba) fere rotata, lobis latis calycem bis terve superantibus; filamentis summo tubo brevissimo insertis basi pubescentibus; ovulis in loculis 6 – 8. — Forma major, *G. liniflora*, Benth., corolla majuscula, lobis lin. 6 – 4 longis. — California.

Var. PHARNACEOIDES (*G. pharnaceoides*, Benth.; Hook. Fl. 2, t.161): minor vel pusilla (*G. tenella*, Nutt. ined.), corollæ lobis 3½ – 2 lin. longis. — California to British Columbia and Rocky Mountains.

3. G. PUSILLA, Benth. Tenella; foliis brevioribus; pedicellis capillaribus; corolla (purpureo tincta seu albida fauce luteola) lobis lato-obovatis fauci subcampanulatæ cum tubo proprio brevissimo æquilongis seu longioribus; filamentis sub sinubus insertis basi fere glabris; ovulis in loculis 3 – 5. — Forma Chilensis, minor, *G. pusilla*, Benth. corolla calyce parum longiore. — Var. CALIFORNICA: corollæ lobis amplioribus calycem bis superantibus. *G. filipes*, Benth. Hartw. p. 325.

4. G. BOLANDERI, n. sp. *G. pusillæ* simillima, differt corolla (cæruleo vel purpureo tincta) tubo angusto calycis tubum cylindraceum subæquante lobis suis fere oblongis cum fauce brevissimo vix ampliata

pl. m. longiore; pedicellis quandoque sesquipollicaribus; ovulis in loculis 2–5. — California, Sonoma County, on dry hills; Russian River, Bolander; — Calaveras Valley, A. Wood. Corolla three or four lines long, with comparatively small lobes, not much surpassing the calyx. From the form of the corolla and the length of its cylindrical tube, this cannot be reckoned a variety of *G. pusilla.*

5. G. AUREA, Nutt. Pl. Gamb. p. 155, t. 22. A basi ramosa diffusa 2–4-pollicaris; foliis hispidulis brevibus, segmentis angusto-linearibus vix lin. 3 longis; pedicellis subcymosis flore majusculo haud longioribus; corolla sæpius flava, lobis late obovatis patentibus fauci ampliato-infundibuliformi cum tubo brevissimo æquilongis; filamentis prope sinus insertis glabris; ovulis in loculis circiter 10. — California, from Santa Barbara or Los Angeles to Arizona and New Mexico. Corolla rather ampliate-funnelform than campanulate, the border 4–6 lines in diameter when expanded, bright or light yellow, sometimes apparently white. — Var. DECORA: corolla alba seu violacea fauce nunc fusco-purpurea. California, Fremont, Brewer, the latter on Monte Diablo.

* * * Flores solitarii paucive ramos terminantes, breviuscule pedicellati. Corolla late breviter infundibuliformis, lobis amplis fimbriolato- seu eroso-dentatis. Filamenta glabra, basim versus corollæ inserta. Ovula numerosa. Folia omnia opposita simplicissima. — *Fenzlia*, Benth. olim. *Gilia* sect. *Dianthoides*, Endl., Benth.

6. G. DIANTHOIDES, Endl. Atakta, t. 29; Hook. Bot. Mag. t. 4876. *G. dianthiflora*, Steud. Nom. *Fenzlia dianthiflora*, Benth. in Bot. Reg. *F. speciosa* & *F. concinna*, Nutt. Pl. Gamb. l. c. — California, from Santa Barbara southward. Flowers variable in size, hue (lilac, purple, or almost white, with yellow or dark purple throat), and in the denticulation of the lobes, which in Coulter's, no. 464, is minute.

§ 2. LINANTHUS, Endl., Benth. Corolla hypocraterimorpha, tubo calycis tubum cylindricum adæquante, lobis late cuneato-obovatis æstivatione valde convolutivis margine obsolete crenulatis vel erosis. Stamina tubo corollæ infra medium inserta, inclusa: filamenta gracilia. Ovula in loculis numerosa (20–40). Capsula oblonga vel cylindracea. — Annuæ, erectæ, glaberrimæ; foliis oppositis 3–5-sectis, inferioribus sæpe (in pauperrimis nunc omnibus) integris, segmentis lineari-filiformibus; floribus terminalibus alaribusque subsessilibus albis; calycis lobis acerosis. — *Linanthus*, Benth. in Bot. Reg.

7. G. DICHOTOMA, Benth. in DC. cum syn. Spithamæa ad subpedalem, grandiflora; corollæ lobis semi-subpollicaribus; antheris linearibus; seminibus subrotundis, tegumento externo laxo arilliformi albo tenui-reticulato ab interiori multo minore soluto, humefactis nec mucilaginosis. — Common in California.

8. G. BIGELOVII, n. sp. Sæpius tenuior, parviflora; corolla calycis lobos vix superante, limbo tubo suo 2–3-plo breviore; antheris ovalibus; seminibus ovalibus, tegumento conformi sub aqua mucilaginoso. — *G. dichotoma*, var. *parviflora*, Torr. Mex. Bound. p. 147. — W. Texas on the Rio Grande and adjacent parts of New Mexico, Bigelow, Wright, to Arizona, Palmer, and Utah, Watson. Leaves sometimes all entire, the upper more commonly trisected. Lobes of the corolla not over two lines in length, cream-white, the outside often reddish.

§ 3. LEPTOSIPHON, Endl., Benth. Corolla hypocraterimorpha, tubo sæpius filiformi elongato, fauce brevissima nunc abrupte plus minus ampliata parum infundibuliformis. Stamina fauci inserta: antheræ breves. Ovula in loculis 6–16. — Annuæ, humiles vel tenellæ; foliis oppositis angustis; floribus sæpius parvulis at latis cum bracteis foliiformibus fulcrantibus capitato-glomeratis. (Stylus in diversis stirpibus aut elongatus plus minus exsertus, aut rarius brevis inclusus!) — *Leptosiphon*, Benth. olim.

* *Palmatifoliæ, Genuinæ*, Californicæ, pilosæ; caulibus foliosis; foliis 5–7-partitis et in axillis fasciculatis, segmentis angusto-linearibus vel filiformibus. Corolla lobis integerrimis. Filamenta gracilia e fauce pl. m. exserta. Ovula in loculis 6–10.

+ *Brevi-Grandifloræ*, validiores; corollæ tubo lobis amplis (semipollicaribus) obovatis parum longiori bracteas villoso-hirsutas raro superante.

9. G. DENSIFLORA, Benth. in DC., cum syn. Prodr. *G. grandiflora*, Benth. l. c. (*Leptosiphon grandiflorus*, Benth. Bot. Reg.): forma tantum, sæpius tenuior, tubo corollæ parum longiori, limbo minori.

+ + *Tenuifloræ*, graciliores, sæpius tenellæ; corollæ tubo lobis ($1\frac{1}{2}$–4 lineas tantum longis) ovalibus ovatisve 3–6-plo longiori. (Species difficillimæ, an confluentes?)

10. G. ANDROSACEA, Steud., Benth. Multicaulis; corollæ (haud flavæ) tubo e bracteis hirsuto- seu villoso-ciliatis longe exserto circa pollicem longo lobis triplo longiori.

Var. DETONSA. Subglabra; bracteis foliisque parum hispidulo-ciliatis. — California, Bridges, Brewer. Nevada near Carson City, Anderson, a somewhat intermediate form.

11. G. MICRANTHA, Steud., Benth. Gracilis; corollæ tubo pertenui (sub-sesquipollicari lobis (lin. 2 – 3 longis) multoties longiori; bracteis foliisque floralibus molliter breviter pubescentibus. — *Leptosiphon parviflorus* & *luteus*, Benth. Bot. Reg. *L. parviflorus* var. *rosaceus*, Hook. f. Bot. Mag. t. 5863 (*Gilia longituba*, Benth. Pl. Hartw.): forma spectabilis corolla majuscula læte rosea. — Corolla lutea, albida, nunc lilacina vel rosea, nunc aurea (var. *aurea*, Benth. l. c.).

12. G. TENELLA, Benth. Pl. Hartw. Depressa, parvula; corollæ tubo minus attenuato lin. 6 – 9 longo, lobis sesquilineam longis (roseis lilacinisve fauce lutea); bracteis etc. hispidulo-ciliatis. *L. bicolor*, Nutt. Pl. Gamb. l. c. chiefly. — The most northern in range, from Santa Barbara to Puget Sound. Has been confounded with the preceding.

13. G. CILIATA, Benth. l. c. Rigidior, hirto-pubescens, 3 – 12-pollicaris; corollæ tubo (lin. 6 – 7 longo) ultra bracteas hirsutissimo-ciliatas vix exserto, lobis sesquilineam longis; calycis lobis acerosis. — N. California to the borders of Nevada.

* * *Simplicifoliæ*, glaberrimæ, pygmeæ; internodio infra capitulum nunc prolifer unico; foliis bracteisve ovato- nunc subangusto-lanceolatis. Corollæ lobis cuneatis margine repando vel 1 – 3-dentato. Antheræ fauce inclusæ sessiles. Ovula in loculis 10 – 16.

14. G. NUDICAULIS. *Collomia nudicaulis*, Hook. & Arn. Bot. Beech. — S. E. Oregon, Tolmie. Nevada, &c., Anderson, Stretch, Watson. South Park, Colorado, E. Hall, a diminutive form. There are no leaves from the persistent oval cotyledons up to the head, from half an inch to three inches. Corolla white, pink, or yellow, the exserted tube three or four lines long.

§ 4. SIPHONELLA. *Leptosiphon* referens, sed corollæ tubus calycem haud superans, faux magis infundibuliformi-ampliata, ovula in loculis pauca, flores minus congesti. — Perennes basi nunc suffrutescente, pube minuta molli subcinerea. Calyx cylindraceus, firmus, striatulus, mox 5-partitus, lobis lanceolato-subulatis, marginibus crassiusculis sinubusque haud membranaceis vel scariosis.

Corolla alba fauce flava, tubo extus puberulo, lobis obovatis. Filamenta brevia e fauce subexserta: antheræ ovali-oblongæ. — *Siphonella*, Nutt. in herb.

15. G. NUTTALLII, n. sp. Spithamæa ad pedalem; caulibus e basi suffrutescente plurimis simpliciusculis; foliis 3 – 7-partitis internodio sæpius brevioribus, segmentis angusto-linearibus mucronatis (lin. 6 – 9 longis); floribus in glomerulum foliosum confertis; ovulis in loculis binis. — *Siphonella montana* & *S. parviflora*, Nutt. herb. — Rocky Mountains of Colorado and Utah to the Sierra Nevada in California, Nuttall, Fremont, Anderson, Brewer, Watson. — Tube of corolla four or five, the lobes two or three lines long.

16. G. FLORIBUNDA, n. sp. Ultrapedalis; caulibus e basi frutescente ramosis gracilibus; foliorum segmentis fere acicularibus internodia sæpius adæquantibus; floribus laxiuscule corymboso-cymosis, nonnullis pedicellatis; ovulis in loculis 4: cæt. fere præcedentis. — California, probably on S. E. borders, Coulter, no. 454. Lower California 50 miles S. of San Diego, E. W. Morse, 1866, ex A. Wood. Pine woods of Arizona, Coues and Palmer, 1865. — Flowers "delicate-scented," rather larger and much more numerous than those of *G. Nuttallii* (some forms of which nearly approach it), either densely or loosely cymose-clustered at the extremity of copious paniculate or corymbose branchlets.

§ 5. LEPTODACTYLON, Benth. Corolla hypocraterimorpha, tubo e calyce demum pl. m. exserto, fauce subinfundibuliformi-ampliata. Stamina fauci vel infra faucem inserta: filamenta brevia vel brevissima: antheræ breves inclusæ. Ovula in loculis plurima. Semina tegumento conformi, humefacta nec mucilaginosa nec spirillifera! — Perennes, suffruticosæ, nunc cæspitosæ, foliosissimæ; foliis alternis vel in unica oppositis et in axillis fasciculatis palmatipartitis, segmentis integerrimis cum calycis lobis acerosis subulatisve pungentibus; floribus roseis lilacinis albisve concinnis aut cymuloso-confertis aut solitariis ramulos breves terminantibus sessilibus. — *Leptodactylon*, Hook. & Arn.

* Folia in caulibus brevibus fere herbaceis opposita!

17. G. WATSONI, n. sp. Hirtello-scabrida, subglandulosa, nunc glabrata; caulibus gracilibus (circ. spithamæis) fere herbaceis e caudice lignescente crasso; foliis 3 – 5-partitis patentissimis, segmentis tenui-acerosis internodiis sæpe brevioribus; calycis lobis tubo dimidio brevi-

oribus; corolla alba fauce subpurpurea; antheris faucialibus; ovulis in loculis circa 10. — Wasatch Mountains, Utah, Watson. Tube of the corolla and lobes each half an inch long. Connects *Leptodactylon* intimately with the two preceding sections of *Gilia.*

* * Folia omnia alterna, rigidiora, et in axillis crebre fasciculata. Suffrutices.

18. G. Californica, Benth. in DC. Ramis foliisque creberrimis mox patentissimis primum laxe tomentoso-pubescentibus; corollæ roseæ seu lilacinæ lobis amplis late cuneato-obovatis sæpe erosulis; antheris lineari-oblongis infra faucem; ovulis in quoque loculo 20–25. *Leptodactylon Californicum,* Hook. & Arn. Bot. Beech. p. 369, t. 89, Bot. Mag. t. 4872. — California south to San Bernadino. Limb of the showy corolla an inch and a half in diameter.

19. G. pungens, Benth. l. c. Viscido-pubescens, puberula, vel glabrata; foliis plerumque erectiusculis vel strictis; corollæ roseæ albidæ seu flavidæ lobis fere dimidio minoribus sæpius angustioribus; antheris faucialibus oblongis; ovulis in quoque loculo 8–10. *G. pungens* & *G. Hookeri,* Benth. l. c., cum syn. — Plains of the upper Platte and Columbia to E. California and Arizona. Very variable: the original *Cantua pungens,* Torr., from the Platte, is a low and minutely pubescent or nearly glabrous form. — Var. cæspitosa (*Leptodactylon cæspitosum,* Nutt. Pl. Gamb.): pulvinato-depressa, glabrescens, subherbacea. Upper Platte. — Var. Hookeri (*Phlox Hookeri,* Dougl. in Hook. Fl. t. 159): forma elatior viscido-pubens, foliis in ramis floridis nunc sparsioribus. The flowers not found of "bright yellow" color, as noted by Douglas. — Var. squarrosa: segmentis foliorum subulatis validioribus patentibus vel squarroso-recurvis. Arid districts of Nevada and Utah, coll. Anderson, Watson, &c.

Series II. *Pinnati-Alternifoliæ,* nempe foliis pinnatisectis lobatis dentatisve rarissime integerrimis. Semina humefacta tegumento mucilaginoso tubulos spirilliferos porrigente (no. 44, 47, 48, 59, 60, exceptis).

§ 6. NAVARRETIA. Flores capitato-glomerati, crebre foliaceo-bracteati. Calycis lobi, uti bractearum, rigidi, acerosi, spinulosi nunc laciniati, nunc inæquales. Corolla tubuloso-subinfundibuliformis, gracilis, lobis parvulis oblongis. Stamina sub fauce inserta: antheræ breves. Ovarium quandoque dimerum. Annuæ, fere semper Californicæ, sæpius viscidæ, nunquam albo-lanatæ, foliis

1–2-pinnatifidis incisisve, lobis plerumque pungentibus. Bracteæ in nonnullis palmatifidæ. (Semina humefacta tubulis cellulisve spirilliferis minus elongatis.) — *Navarretia*, Ruiz & Pav., Benth. *Ægochloa*, Benth. olim.

* Folia nonnulla plus minus bipinnatifida vel incisa: stamina fauce corollæ violaceæ inclusa, sæpius inæquilonga, vix inæqualiter inserta: ovula in loculis 8–12. Herba viscida, fœtida.

20. G. SQUARROSA, Hook. & Arn. Bot. Beech. p. 151. (*Hoitzia squarrosa*, Eschsch.) *G. pungens*, Hook. Bot. Mag. t. 2977. *Navarretia*, Hook. & Arn. *squarrosa*, Hook. & Arn. l. c. p. 368; Benth. cum. syn. Prodr.

* * Folia plera vel nonnulla bipinnatifida vel incisa: stamina e fauce exserta: ovula in loculis 1–4.

+ Rigida, validior, 5–12-pollicaris.

21. G. COTULÆFOLIA, Steud. *Navarretia pubescens* et *cotulæfolia*, Benth.: the former more pubescent; the latter as commonly with cells uniovulate, even in original specimens; both sometimes biovulate. The name here retained is the better one; moreover, the herbage is said by Professor Brewer to exhale the odor of *Maruta Cotula*.

+ + Graciliores vel demissæ.

22. G. INTERTEXTA, Steud. Erecta, nunc patenti-ramosa, nec viscida nec glandulosa, pube alba in caule subrobusto (3–7-pollicari) retrorsa hirsuta; foliis glabratis, segmentis aceroso-spinescentibus divaricatis simpliciusculis; floribus arcte glomeratis; calycis tubo cum basi bractearum albo-hirsutissimo, lobis corollam albam adæquantibus; ovulis seminibusque in loculis 3–4. — *Navarretia intertexta*, Hook. Fl. p. 75. — Columbia River to Northern California and the Rocky Mountains.

23. G. MINIMA. Depressa, subpollicaris, nunc cæspitans, glabrata; foliis minus divisis acicularibus; calycis tubo glabello sinubus latis tantum albo-piloso lobis inæqualibus (corollam albam subæquantibus) æquilongo; ovulis in loculis 1–3. — *Nav. minima*, Nutt. Pl. Gamb. p. 160. — Arid interior of Oregon and Nevada to Colorado (Nicollet, Geyer, Vasey, &c.).

24. G. BREWERI, n. sp. Erecta, nunc diffuso-ramosissima, 1–6-pollicaris, undique minutissime glanduloso-pubera; segmentis foliorum subsimplicibus aciculari-subulatis; floribus minus glomeratis; calycis lobis conformibus angusto-subulatis tubo suo (capsulam breviore) 3–

4-plo longioribus corollam flavam (lin. 3 – 4 longam) adæquantibus; ovulis in loculis 1 – 3. — Sierra Nevada, at Ebbett's and Amador Pass, alt. 8,000 feet, Brewer. From the W. Humboldt Mountains, Nevada, to the Wasatch, 6 – 9,000 feet, S. Watson.

25. G. LEUCOCEPHALA. Gracilis, 3 – 6-pollicaris, haud glandulosa; ramis infra capitulum densum retrorsim pubescentibus; foliis subflaccidis glabris, segmentis filiformibus sæpius indivisis, floralibus etiam vix pungentibus; calycis tubo sinubus saltem villoso-pubescente; corolla alba (lin. 4 longa) calycem superante, lobis staminibus sæpius brevioribus; ovulis in loculis 2. — *Navarretia leucocephala*, Benth. Pl. Hartw. p. 324. — California, chiefly on the Sacramento and its tributaries.

26. G. NAVARRETIA, Steud., *Nav. involucrata*, Ruiz & Pav., the original and only Chilian species, appears to be nearer *G. leucocephala* than to *G. cotulæfolia;* but in fact the three species approach each other too nearly.

* * * Folia semel pinnatifida vel incisa, paucave fere integerrima: stamina e fauce corollæ violaceo-purpureæ nunc albæ vel luteolæ pl. m. exserta: calycis lobi integerrimi vel in *G. viscidula* rariter laciniati.

+ Gracillimæ, ramis foliisque paucisectis filiformibus: bracteæ fere palmatipartitæ.

27. G. FILICAULIS, Torr. in herb. Erecta, spithamæa, superne minutissime glandulosa; ramis tenellis pedunculiformibus effuse paniculatis; foliorum segmentis rhachique subsetaceis; corollæ violaceæ tubo tenero calycis lobos lanceolato-subulatos parum pungentes longe superante; ovarii loculis uni-(raro bi-?) ovulatis. — California, Jeffray, no. 1474, in herb. Kew. Also Bear Mountain, Mariposa County, Torrey. Leaves sparse. Heads small, rather naked. Flowers nearly three lines in length, exceeding the palmately few-cleft inner bracts.

28. G. DIVARICATA, Torr. in herb. Diffusa, nunc patentissima, 3 – 6-pollicaris, superne viscidulo-pubescens, ramis proliferis pedunculiformibus; foliorum segmentis rhachique subulato-filiformibus, bractearum magis pungentibus; corollæ purpureæ vel luteolæ tubo infundibuliformi calycis lobis setaceo-subulatis pungentibus parum longiore; ovarii loculis 5 – 7-ovulatis. — California, along the foot hills of the Sierra Nevada, coll. Shelton, Rattan, Bolander, Torrey, Mrs. Davis, C. Lee. — Flower from three to five lines long.

+ + Validiores, viscidæ; foliis rigidis superioribus præsertim a basi dilatatis, lobis dentibusve spinulosis vel spinosis: capitulis densis.

29. G. VISCIDULA. *Nav. viscidula*, Benth. Pl. Hartw.— Apparently common and widely spread in California. The lobes of the calyx more usually entire. It is described as with solitary ovules in the cells; but two are more commonly found, even in Hartweg's specimens; while in robust forms of what is otherwise indistinguishable from the species, collected by Bridges, Fitch, Samuels, Bolander, &c., there are three or four ovules in each cell!

30. G. ATRACTYLOIDES. *Nav. atractyloides*, Hook. & Arn. — California, from Monterey to San Diego.

+ + + Depressæ, parum viscidæ; foliis rigidis versus apicem dilatatis, dentibus lobisve cum calycis segmentis longe setiferis; floribus vix congestis.

31. G. SETOSISSIMA. *Navarretia setosissima*, Torr. & Gray, Bot. Ives Colorado Exped. p. 22. Ovula in loculis 6 – 10. — Var. EXIGUA, ovulis in loculis 3 – 5. *N. Schottii*, Torr. Bot. Mex. Bound. p. 145. — Arizona and S. E. California on the Mohave, &c., Coulter, Fremont, Newberry, Schott, Cooper.

§ 7. HUGELIA. Flores capitato-glomerati, crebre foliaceo-bracteati; bracteis 3 – 5-fidis basi calycibusque lana longa implexa albida vestitis, lobis utriusque acerosis subulatisve cuspidatis. Corolla plerumque cærulea hypocraterimorpha, tubo gracili, lobis sæpius oblongis. Antheræ exsertæ, nunc lineari-sagittatæ, nunc breves. Ovula numero perquam variabilia! — Plantæ humiles, juniora præsertim floccoso-lanatæ, haud viscidæ, foliis semel pinnatipartitis paucisve integris acerosis vel subulato-filiformibus. — *Hugelia*, Benth. in Bot. Reg. *Gilia* sect. *Collomioides* (Endl.) & *Pseudocollomia*, Benth. in DC.

In this group I can make nothing of the number of the ovules, even as a specific character. In two specimens apparently exactly alike, one has three or four, the other only two, ovules in each cell: sometimes there is a pair in one or two of the cells, and a solitary one in the other. In none have I detected the maximum number mentioned in the Prodromus, i. e. ten in each cell. The *Hugelia lutea*, Benth., probably had not yellow flowers. The tube of the corolla lengthens with age in all the species. *Gilia gossypifera* is better placed in the next section.

* Perennis, caulibus rigidis e basi suffruticosa: antheræ lineari-*sagittatæ.*

32. G. DENSIFOLIA, Benth. G. (olim *Hugelia*) *densifolia* & *elongata*, Benth. l. c. — No other specimens of *G. densifolia* have been found exactly answering to those of Douglas; these have 5 – 7 (according to Bentham about 10) ovules in each cell, those of *G. elongata* only two or three. Specimens collected by Xantus at Fort Tejon, and by Dr. Cooper on the Mohave, are as near as may be intermediate.

* * Annuæ, graciliores, demum paniculato-ramosæ, foliis segmentisve sæpius paucis filiformibus.

33. G. VIRGATA, Steud., Benth. l. c. Primum stricticaulis, simplex; antheris (in sicco) linearibus sagittatis lineam longis. — *Hugelia virgata*, Benth., Hook. Ic. t. 200 (anthers figured too short). The ordinary form has most of the cauline leaves entire, and the upper of few divisions. Lobes of the corolla three lines long.

Var. FLORIBUNDA: corymboso-ramosa; capitulis majoribus multifloris; foliis magis dissectis. — California, Fitch, Wallace, Brewer. Ovules vary from two to five in each cell.

34. G. FLOCCOSA. Gracilior, spithamæa, demum diffusa paniculata; antheris lineari-oblongis vix semilineam excedentibus; floribus minoribus; ovarii loculis nunc uni- nunc bi- rarius 3 – 4-ovulatis. — *Hugelia lutea*, Benth. in Bot. Reg. *Gilia* (*Pseudocollomia*, Benth.) *lutescens*, Steud., Benth. in DC. — California to Arizona, interior of Oregon, and Utah. Flowers blue or pale purple, becoming white only in age, and though appearing yellowish in original dried specimens of Douglas, probably never yellow. Hence a new specific name is required. Nuttall has an unpublished *Hugelia floccosa* in his herbarium, but with no flowers developed; and, as it is either this or the next, the name may be applied to the present species.

35. G. FILIFOLIA, Nutt. Gamb. p. 156. Gracilis, spithamæa et ultra, rigidula; foliis plerisque tripartitis; antheris ovalibus minimis; corollæ tubo parum exserto; ovarii loculis sæpius 4 – 6-ovulatis. — Santa Barbara and San Isabel, California, Nuttall, Thurber; and Fort Mohave, Cooper.

Var. DIFFUSA: laxa, nunc ramosissima. — Fort Mohave and Nevada to New Mexico and the borders of Texas. Lobes of the pale purple or blue corolla only one or two lines long: anthers only a quarter or one third of a line in length. Forms of this approach the preceding too nearly.

(G. LANATA, Lindl. Jour. Lond. Hort. Soc. 3, p. 74, said to come from Mexico, of which I know only the character, is probably a form of *G. virgata* or of *G. filifolia*.)

§ 8. ELAPHOCERA, Nutt. Flores capitato-congesti, bracteati, raro cymoso-laxiusculi. Corolla (alba) hypocrateriformis, tubo calycis lobos sæpius mucronato- vel cuspidato-apiculatos (haud pungentes) adæquante vel paullo (rarius duplo) superante. Stamina corollæ lobis ovalibus oblongisve plus minus breviora, sinubus sæpius inserta. — Herbæ biennes vel perennes vitæ ut videtur brevis, nunc annuæ, humiles; caulibus fere semper lanoso-pubescentibus; calycibus bracteisque pilis longis viscidulis multiarticulatis crinitis; foliis semel pinnatifidis vel integris.

* Folia integerrima angustissima: flores capitato-congesti: filamenta gracilia, exserta, sed corollæ lobis breviora.

36. G. WRIGHTII, n. sp. Caulibus virgatis rigidis circa pedalibus e basi lignescente seu radice forte perenni? usque ad apicem foliosis; foliis rigidis cuspidato-mucronatis; bracteis lato-lanceolatis hinc inde laciniatis cum calycis lobis subulatis aristato-cuspidatis ciliatis; corollæ lobis oblongis tubo parum exserto (lin. 4 longo) dimidio brevioribus; antheris brevi-oblongis; ovulis in loculis 3 – 4. — Western frontiers of Texas, on the Rio Grande forty or fifty miles below El Paso, C. Wright, no. 496. In habit like a *Hugelia:* flowers white or faintly bluish.

37. G. GUNNISONI, Torr. & Gray, Pacif. R. R. 2, p. 129, t. 9. Annua, subglabra, sparsifolia, laxe paniculato-ramoso, ramis capitulo parvo quasi pedunculato terminatis; ovulis in loculis 2 – 3. — The figure is characteristic. We have it only from Green River, Utah, Kreusfeldt, and San Juan, New Mexico, Newberry. The plants referred to in Bot. Mex. Boundary are different: Wright's 1642 is *G. filifolia* var. *diffusa*.

* * Folia aut omnia aut nonnulla in lobos paucos angusto-lineares partita, raro omnia integra: filamenta corollæ lobis breviora: flores arcte capitato-glomerata. — Herbæ biennes vel perennes, caudice vel radice dura.

38. G. SPICATA, Nutt. Pl. Gamb. l. c. Caulibus validis erectis (4 – 10-poll.) superne capitula plurima in spicam longe virgatam interruptam foliosam congesta gerentibus; foliis nunc trifidis nunc integerrimis cum calycis lobis fere muticis; corollæ lobis oblongo-ovatis tubo vix exserto breviore; antheris fauce subsessilibus; ovulis in loculis

4–6. — Benth. Kew Jour. 3, p. 290. *G. spicata* & *G. trifida*, Nutt. l. c. Rocky Mountains, Colorado, Nuttall, Fremont, Geyer, Parry, Hall & Harbour. — Var. CAPITATA: forma minor, foliis integerrimis, floribus in capitulo unico terminali. Rocky Mountains, Hall & Harbour, no. 461.

39. G. CONGESTA, Hook. Caulibus erectis vel diffusis (3–12-poll.) e basi subcæspitosa; capitulis florum solitariis vel paucis corymbosis densis; foliis 3–7-partitis paucisve integerrimis, lobis ut calycis aristulato-mucronatis; corollæ lobis ovalibus tubo suo haud exserto vix brevioribus; filamentis sinubus insertis antheras adæquantibus vel excedentibus; ovulis in loculis 2–4. — Hook. Fl. & Ic. t. 235. Colorado and Nebraska, to Oregon and California in the Sierra Nevada.

Var. CREBRIFOLIA. Depressa; caulibus (2–3-pollicaribus) foliosissimis monocephalis; foliis aceroso-subulatis integris parvis (lin. 3–6 longis). — *G. crebrifolia*, Nutt. Pl. Gamb. l. c. — Rocky Mountains, on Big Sandy River, Colorado, Nuttall. Specimens from Bear River Valley, Utah, Watson, connect this with *G. congesta*.

40. G. IBERIDIFOLIA, Benth. Kew Jour. 3, p. 290. Præcedenti peraffinis; foliis rigidioribus bracteisque cuspide validiore mucronatis; capitulis corymbosis laxioribus; filamentis brevioribus; ovulis in loculis solitariis! — Scott's Bluffs, North Platte, Nebraska, Geyer; and Blackwater of the same, H. Engelmann. Not elsewhere met with. Perhaps a form of *G. congesta*.

* * * Folia omnia vel plera pinnatifida vel trifida: flores conferte cymulosi demum laxiusculi, folioso-bracteati: calycis lobi cum bracteæ aristulato-cuspidati. Annuæ, humiles, e basi ramosæ.

41. G. GOSSYPIFERA, Gillies, ex Benth. in Prodr., of the Andes of Mendoza, is evidently of this section, and most like the following.

42. G. PUMILA, Nutt. Pl. Gamb. (1849). Caulibus laxe lanosis foliosis; foliis angusto-linearibus integris vel in lobos 2–5 lineares divergentes partitis; corollæ tubo (lin. 3–4 longo) gracili lobis suis 3–4-plo calycis lobis duplo longioribus; filamentis gracilibus sinubus insertis corollæ lobis parum brevioribus; ovulis in loculis 5–6. — *G. trifida*, Benth. Kew Jour. l. c. Western borders of Texas and New Mexico, Fendler, Wright, Bigelow, &c., to the Platte, Nuttall, Geyer, and Utah, S. Watson.

43. G. POLYCLADON, Torr. Bot. Mex. Bound. Caulibus diffusis subnudis parce pubescentibus vel puberulis; foliis pinnatifidis incisisve, lobis brevibus oblongis abrupte spinuloso-mucronatis, floralibus flores

superantibus; corollæ tubo (sesquilineari) calycem vix superante; limbo parvo; antheris fauci insertis subsessilibus; ovulis in loculis 2. — New Mexico and western frontiers of Texas, Wright, Bigelow, to Utah, S. Watson.

§ 9. IPOMOPSIS, Benth, pro parte. Flores thyrsoideo-paniculati, parum bracteati. Corolla (plerumque coccinea) tubuloso-infundibuliformis, tubo sensim sursum ampliato calycis lobos subulatos suosque lobos ovatos seu lanceolatos patentes multum superante. Stamina fauci corollæ vel sub sinubus inserta, lobis haud longiora. Ovula in loculis plurima. — Biennes, glabellæ seu pilosulæ; caulibus elongatis; foliis semel pinnatifidis; floribus speciosis. *Ipomopsis*, Michx. *Ipomeria*, Nutt.

I confine this group to the original species and two others nearly related to it. As arranged by Bentham it comprised two or three here referred to *Eugilia*. As to *G. longiflora* and *G. glomeruliflora*, they prove to have very unequally inserted stamens, which is the sole character of *Collomia*. The tendency to dimorphism, of which there are traces, or perhaps rather incipient manifestations, in various portions of the genus, is most marked in *G. aggregata*. The included stamens of *G. subunda* perhaps belong to the short-stamened form of the species, but no other is known.

* Caules alte foliosi, foliis pinnatipartitis, segmentis filiformibus seu angusto-linearibus.

44. G. CORONOPIFOLIA, Pers., Benth. cum syn. Prodr., et *G. Floridana*, Don, & *G. Beyrichiana*, Bouché. Elata; thyrso virgato compacto; corollæ lobis ovatis subpatentibus filamentis parum longioribus; seminibus humefactis nec mucilaginosis nec spirilliferis! tegumento externo laxo et grossius et tenuissime reticulato. — South Carolina to Florida and Texas.

45. G. AGGREGATA, Spreng., Torr. Bi–quadripedalis, versus paniculam laxam sæpe ramosam nudiuscula; floribus suaveolentibus; calyce sæpissime glanduloso, lobis subulatis; corollæ tubo angusto, lobis ovatis seu lanceolatis acutis patentissimis mox recurvis; filamentis aut e tubo exsertis aut inclusis; seminibus mucilaginosis et spirilliferis modo generis. — *G. aggregata* (*Cantua*, Pursh!) & *G. pulchella* (Dougl.), Benth. cum syn. Prodr. — From Upper Platte and Missouri to the Columbia and the Pacific, and south to Arizona. The original *Cantua aggregata* is one of the forms with long and narrow calyx-lobes. The opposite extreme is —

Var. Bridgesii: calycis lobis lato-subulatis immo deltoideis; caulibus sesquipedalibus laxis parce foliatis; laciniis foliorum obtusissimis; floribus parcis. — California, Bridges, &c.

* * Caules subpedales superne nudi, foliis subpinnatifidis.

46. G. subnuda, Torr. in herb. Glanduloso-puberula; foliis ad basin caulis superne aphylli laxe ramosi confertis spathulatis oblongisve (pollicaribus) breviter inciso-lobatis; floribus paucis subconfertis; corollæ coccineæ vel aurantiacæ tubo semipollicari lobis ovatis obtusis triplo longiore; antheris subsessilibus fauce inclusis. — Nevada and Arizona or New Mexico, Newberry, Stretch, Palmer.

§ 10. GILIANDRA. Flores thyrsoideo-paniculati. *Ipomopsidis.* Corolla (alba vel subcærulea) hypocraterimorpha, tubo calycem subduplo superante lobis suis obovatis parum longiore. Filamenta sub sinubus inserta, longe (ultra corollæ lobos) exserta: antheræ ovatæ. Ovula in loculis 6–8. Semina nec mucilaginosa nec spirillifera! — Biennes, glanduloso-puberula, foliis semel pinnatifidis, floribus parvulis.

47. G. stenothyrsa, n. sp. Caule e radice crassa erecto (spithamæo ad subpedalem) simplici valido usque ad thyrsum virgatum racemiformem folioso; foliis floralibus bracteisque parvulis integerrimis, cæteris in lobos breves oblongos pinnatifidis. — Utah, in a "cedar forest," Uintah Mountains, Fremont. Corolla, half an inch long, apparently white.

48. G. pinnatifida, Nutt. in herb.; Gray Enum. Pl. Parry. Spithamæa ad sesquipedalem, inferne glabrata; panicula composita laxe ramosa; foliis in lobos lineares vel angusto-oblongos rariter 1–2-lobatos pinnatipartitis; bracteis linearibus subulatisve parcis; staminibus longe exsertis. — N. New Mexico and Colorado to Snake River, &c., in or near the Rocky Mountains, Nuttall, Fendler, and various collectors. A part of Geyer's 42 and 25, referred to *G. inconspicua*, belongs here. Tube and lobes of the corolla each about two lines, the much exserted stamens three lines long. Seeds with a close coat, wholly unchanged when wetted.

§ 11. MICROGILIA, Benth. in DC. Flores secus ramos graciles laxe spicatim vel paniculatim dissiti. Calyx brevi-campanulatus, 5-dentatus. Corolla (alba) hypocraterimorpha, tubo e calyce paullo exserto lobis duplo longiore. Stamina tubo inserta, inclusa: antheræ brevissimæ. Ovula in loculis solitaria! — Annuæ, subglabræ, ramosissimæ; foliis fere filiformibus seu ramealibus tenui-subulatis integerrimis caulinisve tripartitis, floribus minimis.

49. G. MINUTIFLORA, Benth. l. c. Rigidula, subscoparia, 1–2-pedalis; foliis caulinis nonnullis 3-partitis, ramealibus subulatis; floribus terminalibus sæpeque secus ramulos strictos quasi spicatis; corollæ (lin. vix 2 longæ) tubo angusto lobis suis calyceque duplo longiore; filamentis gracilibus; capsula ellipsoidea (lin. 2 longa); semine oblongo. — *Collomia* (*Picracolla*) *linoides*, Nutt. Pl. Gamb. p. 159. — Interior of Oregon (not "California"), Douglas; Colorado and Wyoming, on the Upper Platte, Nuttall, Fremont.

50. G. TENERRIMA, n. sp. Effuse ramosissima, humilis; ramis ramulisque filiformibus; foliis brevibus integris; floribus laxe paniculatis minutis; pedicellis tenuibus divaricatis; capsula subglobosa (vix lineam longa); semine ovoideo. — Utah, on hills above Bear River, near Evanston, Watson in C. King's expedition.

§ 12. EUGILIA. Flores paniculati, sparsi, vel in prioribus capitato-glomerati, sæpius ebracteati. Corolla (cærulea, purpurea, vel alba) infundibuliformis, seu in ultimis fere campanulata vel rotata. Filamenta gracilia, ad vel prope sinus corollæ inserta, lobos haud superantia. Ovula in loculis pauca vel plurima. — Folia pinnato-incisa vel dissecta. — *Gilia* sect. *Eugilia* cum spec. *Ipomopsidis* nonnullis, Benth.

* Flores in cymam capituliformem longe pedunculatam digesti. Stamina sinubus ipsis corollæ brevis inserta, lobis æquilonga. Ovula plurima. — Annuæ, Californicæ, erectæ; foliis 2–3-pinnatipartitis, segmentis angustissimis; corollis sæpius cæruleis.

51. G. CAPITATA, Dougl. Corollæ lobis lineari-lanceolatis, fauce parum ampliata; calyce sæpius glabro.

52. G. ACHILLEÆFOLIA, Benth. Flores majores; corollæ lobis obovatis late oblongisve fauce abrupte insigniter ampliata; calyce pl. m. lanoso.

* * Flores in prioribus subcongesti, in cæteris laxe paniculati vel dissiti. Corolla infundibuliformis fauce plus minus ampliata. Seminis testa spirillifera modo generis. Annuæ, humiliores, nunc diffusæ.

+ Pluriovulatæ.

53. G. MULTICAULIS, Benth. cum syn. Prodr. *G. stricta*, Scheele in Linnæa, 21, p. 755? *G. millefoliata*, Fisch. & Meyer: forma diffusa

foliosa parviflora. (Calyx-teeth in char. "tubo suo duplo brevioribus," not "longioribus" as in Prodr.) — Var. TENERA: *forma depauperata exili, pedunculo sæpe unifloro. G. stricta*, Liebm. Ind. Hort. Hafn. 1853, ex char. California. To this, or perhaps to the preceding species, may probably belong *Polemonium capitatum*, Esch. Mem. Acad. Petrop.

54. G. LACINIATA, Ruiz & Pav.: known from the smaller and sparser-flowered forms of the preceding by its oblong capsule. Chili, &c.

55. G. TRICOLOR, Benth. One form has a glabrous calyx, &c. California.

56. G. TENUIFLORA, Benth., Lindl. Bot. Reg. &c., 1888. California, not common. — Var. LATIFLORA. Corollæ tubo calyce aut paullo aut duplo longiore, fauce lobisque amplioribus. Los Angeles County? Fremont, Wallace.

57. G. INCONSPICUA, Dougl. — Columbia River to the Platte and Arizona. The corolla is not hypocrateriform, as described and figured in Bot. Mag. t. 2883, at least when fully developed. It is usually ampler; and to the species (which is a widely variable one) I must refer back *G. sinuata*, Dougl., Benth. in DC., the flowers of which sometimes attain thrice the size, and nearly connect with the var. *latiflora* of the preceding! *G. arenaria*, Benth. (collected on the sea-beach at Monterey by Rich and Parry), is a glandular-viscid form, with more slender corolla (half an inch long), which is likely to pass into *G. tenuiflora*. — Geyer's no. 25 and 42, referred to *G. inconspicua* by Hooker, is partly of that species, partly *G. pinnatifida.*

+ + Pauci- (in loculis 2 – 3-) ovulatæ.

58. G. CRASSIFOLIA, Benth. Chili, &c. Near *G. inconspicua.*

* * * Flores effuse paniculati, longius pedicellati, minimi. Corolla tenui-infundibuliformis vel subcampanulata (alba seu albida): stamina juxta sinus inserta, lobis breviora. Ovula numerosa. Semina humectata mucilagine spirillisque destituta! — Annuæ, pusillæ, e basi ramosissimæ, foliis radicalibus semel pinnatifidis vel incisis.

59. G. LEPTOMERIA, n. sp. Parum glandulosa, floribunda; foliis radicalibus spathulatis seu lanceolatis leviter pinnatilobatis, caulinis fere integris linearibus, ramealibus bracteisve minimis; pedicellis erectis flore longioribus seu brevioribus; corolla angusto-infundibuliformi sesquilineari demum elongata (ad lineas 3) fere hypocrateri-

morpha, tubo calyce lobis suisque ovatis duplo longiore; ovulis in loculis plurimis (seminibus $\frac{1}{32}$ unc. longis). — Mountain valleys of Nevada and Utah, S. Watson. Resembles some most depauperate and small-flowered forms of *G. inconspicua;* yet well marked by the narrow corolla and especially by the seeds.

60. G. MICROMERIA, n. sp. Fere glabra; tenella, laxa; foliis inferioribus pinnatifidis lobis oblongis obtusis divaricatis, cæteris linearibus integerrimis; floribus sparsis; pedicellis filiformibus elongatis patentibus demum recurvis; corolla oblongo-campanulata lineam longa calycem parum superante, lobis brevibus; ovulis in loculis vix ultra 6; capsula subglobosa stylo longiore. — Mountain valleys of Nevada and Utah, S. Watson. Seeds as in the preceding.

* * * * Flores sparsi longius pedicellati, sat magni. Corolla aut campanulata aut rotata. Calycis lobi lanceolato-subulati, tubo suo longiores. Antheræ sæpius oblongæ. Humiles seu gracilescentes, diffusæ.

+ Annuæ, floribus parvulis.

++ Corolla campanulata.

61. G. CAMPANULATA, n. sp. Parum viscidulo-pubens, 2–3-pollicaris; ramis patentibus; foliis inferioribus lanceolatis parce pinnatifido-dentatis, ramealibus lineari-lanceolatis sæpe integerrimis; pedicellis flore interdum brevioribus; corolla campanulata (alba?) calyce duplo longiore leviter 5-loba; staminibus basi latæ corollæ insertis inclusis; ovulis in loculis 6–7. — Foot hills of Trinity Mountains, Nevada, Watson. — Corolla three or four lines long; the broad lobes less than half the length of the ample (yellowish?) throat, at the base of which the stamens are inserted: no narrowed tube. This and the two preceding species are among the discoveries of S. Watson, in C. King's expedition.

++ ++ Corolla fere rotata.

62. G. INCISA, Benth. in DC. Prodr. *G. Lindheimeriana*, Scheele in Linnæa, 21, p. 763. Multiovulata. — East Texas to Mexico.

63. G. GAYANA, Wedd. Chl. And. 2, p. 82. Pauciovulata; "seminibus in loculis 1–2." — Andes of Chili.

+ + Perennes; floribus majusculis; corolla fere rotata; ovarii loculis pluriovulatis.

64. G. FŒTIDA, Gillies, Benth. l. c. Andes of Chili.

65. G. RIGIDULA, Benth. l. c. *G. glandulosa*, Scheele, l. c. Flowers bright blue, showy, according to Lindheimer opening widely only in direct sunshine late in the afternoon and closing at sunset. — Texas to Arizona and Mexico.

Var. ACEROSA. Rigidior; ramis e basi magis lignosa ad apicem usque crebre foliosis, segmentis foliorum plerisque subulatis vel acerosis subpungentibus; pedicellis flore quandoque brevioribus. North New Mexico to Arizona, Fendler, Gordon, Wright, &c.

4. POLEMONIUM, Tourn.

Corolla ab infundibuliformi ad rotatam. Stamina basim versus corollæ æqualiter inserta: filamenta elongata, sæpissime declinata, basi pl. m. piloso-appendiculata. Ovula in loculis 2–12. Semina humefacta tegumento mox mucilaginoso et spirillifero modo *Collomiæ*. Calyx magis quam in *Gilia* herbaceus, sub sinubus vix scarioso-membranaceus, post anthesin accrescens, lobis muticis. — Herbæ perennes rhizomatibus gracilibus, raro annuæ; foliis semel pinnatis vel pinnatipartitis; floribus cæruleis violaceis seu albis.

§ 1. Corolla infundibuliformis calycem superans, tubo sæpius elongato. Filamenta basi vix dilatata tantum hirsutiuscula. — Perennes, nanæ e rhizomate repente, viscido-glandulosæ, moschatæ, foliolis perplurimis minimis confertis. Transitus ad *Giliam*.

1. P. CONFERTUM, Gray, Proc. Acad. Philad. 1863. Spithamæum; foliolis 3–5-sectis secus rhachin quasi verticillatis vel fasciculatis, segmentis aut late ovalibus aut lineari-oblongis; floribus (mellium spirantibus) capitato-congestis nutantibus demum racemoso-spicatis; calycis lobis angustis tubo cylindraceo seu oblongo plus dimidio brevioribus; corolla cærulea, tubo angusto-infundibuliformi calycem superante lobis suis rotundatis 2–3-plo longiore. — Rocky Mountains from lat. 38° to 49°, Nuttall, Parry, Hall & Harbour, Lyall; E. Humboldt Mountains, Nevada, Watson; and high sierras of California, Brewer. Corolla 9–12 lines long.

Var. MELLITUM, Gray, l. c.: laxius; corolla pallida nunc alba pollicari, tubo angusto lobis quaduplo longiore. — Rocky Mountains, Hall & Harbour, &c. Wasatch Mountains, Utah, Watson.

P. VISCOSUM, Nutt. Pl. Gamb. Humilius; foliolis integerrimis ovatis rotundisve; floribus subcorymbosis; calyce subcampanulato, lobis latioribus tubo subæquilongo corollæ tubum (lobis suis haud longiorem) subæquantibus. — Rocky Mountains, about lat. 40°, Nuttall.

Mixed with dwarfed specimens of the preceding, from which Nuttall's character of "elongated-lanceolate segments of the calyx" was probably taken.

§ 2. Corolla inter campanulatam et rotatam, calyce modice longior. Filamenta basi quasi in lamellam dilatata. — Perennes, foliolis integris, superioribus nunc alato-confluentibus, inflorescentia laxiore.

(P. GRANDIFLORUM, Benth., of Mexico, I do not possess, and have barely seen in herb. Kew.)

2. P. CÆRULEUM, L. Common from the arctic regions and Alaska to California and through the Rocky Mountains, also through Northern Asia to Europe; very rare eastward (in New York and New Jersey). — *P. acutiflorum*, Willd., which is reduced by Ledebour to a variety of this species, is an Alaskan form, with ovate acute lobes to the corolla (Pallas, Chamisso, &c.). All the North American, like the Himalayan, forms of this species incline to have wing-angled seeds, — quite as much so as in

Var. FOLIOSISSIMUM (*P. cæruleum*, var. *pterosperma*, Benth. in DC. Prodr.). Valde viscido-pubescens; caulibus bipedalibus usque ad apicem cum ramis floridis corymbosis foliosissimis; foliolis in rhachin alato-marginatam sæpe confluentibus; floribus minoribus; staminibus styloque corolla (calycem 2–3-plo superante) sæpius brevioribus. — Through the Rocky Mountain region, Geyer, Fendler, Parry, Vasey, Watson, &c. This approaches

3. P. MEXICANUM, Cerv. (Mexico?) This is distinguished by its shorter corolla, and short lobes of the calyx, which are only half the length of its tube.

4. P. HUMILE, Willd. Spithamæum; caulibus laxis 1–2-foliatis; floribus subcorymbosis paucis longius pedicellatis; calyce ultra medium 5-fido; ovulis 2–4 seminibusque 1–2 in quoque loculo. — *P. pulchellum*, Bunge, Ledeb, &c. *P. Richardsonii*, Graham. *P. capitatum*, Benth., non Esch. *P. pulcherrimum*, Hook., a small-flowered form. — Rocky Mountains to those of California, and through the arctic regions and Alaskan islands to Siberia. — *P. capitatum* of Eschscholtz, from the sands of California, with linear leaflets, &c., cannot be this species, — is probably *Gilia multicaulis*, or some allied species of that genus.

5. P. REPTANS, L. Atlantic States from New York south and west to Nebraska.

§ 3. Corolla (albida) fere rotata, calyce brevior. Filamenta basi sensim dilatata, parcissime piloso-ciliata. — Annuæ, debiles, sparsifloræ; foliolis integris.

6. P. MICRANTHUM, Benth. l. c. British Columbia to Nevada.

3. *Miscellaneous Botanical Notes and Characters.* By ASA GRAY.

NAMA, L.

The outlines of a monograph of this genus which, in the year 1861, I contributed to the Proceedings of this Academy (vol. 5, pp. 337–339) have long needed some corrections and additions. The following notes for a revision of the genus were mainly drawn up in the Kew Herbarium, in October, 1869.

§ 1. Folia in caulem alato-decurrentia, obovata vel spathulata, pube molli villosa seu pilosa: rami procumbentes.

N. JAMAICENSIS, L. Pedunculi brevissimi. Semina costato-scrobiculata.

N. BIFLORA, Choisy. Pedunculi filiformes. Semina alveolata. — Mexico, collected only by Berlandier.

§ 2. Folia caulina omnia vel plera basi subamplexicauli sessilia, haud decurrentia, pube molli nec incana. Annuæ.

N. BERLANDIERI, n. sp. *N. undulata* var. *macrantha*, Choisy, Hydrol. t. 2, f. 1. Ramis gracillimis diffusis, foliis sparsioribus tenuioribus ovali-oblongis hinc inde oppositis, pedunculis gracilioribus, corolla majore, capsula oblonga sepalis apice magis dilatatis subdimidio breviore, seminibus obsoletius scrobiculatis, diversa. — Tamaulipas, Mexico, near Reynosa, Berlandier (no. 2116 = 699), who alone has met with it.

N. UNDULATA, HBK. Foliis sæpe undulatis omnibus alternis lineari- seu spathulato-oblongis, inferioribus oblanceolato-spathulatis basi longius attenuatis; caule erecto; pedunculis plerumque brevissimis; capsula matura fere lineari calycem subæquante; seminibus eximie alveolato-reticulatis. — Extends from Texas and New Mexico to the Andes of Chili, Gillies.

§ 3. Folia omnia basi attenuata vel petiolata (nec amplexicaulia nec decurrentia).

* Annuæ, pilis rigidis vel rigidiusculis hirtæ, nec incanæ: folia etiam inferiora basi longius attenuata vix petiolata: sepala anguste exacteque linearia!

N. HISPIDA, Gray, l. c. Semina in loculis 24 – 40, oblonga, haud ultra ¼ lin. longa, obsoletissime rugulosa.

N. DEMISSA, n. sp. E radice exili patenti-ramosissima, 2 – 3-pollicaris, hirsuta; foliis spathulato-linearibus; floribus subsessilibus; seminibus in loculis 10 – 12 ovalibus ⅓ lin. longis obsolete grossius scrobiculato-rugosis; cæt. fere præcedentis. — Dry or desert regions of Nevada, Fremont, Anderson, Torrey, Watson in King's expedition; forms with ample corolla sometimes twice the length of the calyx. Fort Colville, Washington Territory, Lyall, in herb. Kew.: a very low and condensed form, with corolla not exceeding the calyx: characters indicated by Professor Oliver.

* * Annuæ, pube molliori vel breviori parum cinerea: sepala (ut in pleris) sursum pl. m. dilatata.

+ Folia basi attenuata vel acuta, plera (saltem superiora) sessilia vel subsessilia.

++ Semina haud ultra ¼-lineam longa, lato-ovalia, sublævia, obsoletius costata et areolata.

N. SANDWICENSIS, Gray, l. c. Ramosissima, pube crebra hirsutulo-cinerea; foliis brevibus spathulatis margine mox revolutis; pedunculis calyce longioribus vel brevioribus; floribus parvis; corolla calycem parum superante; capsula ovali.

N. COULTERI, n. sp. Laxe ramosissima, spithamæa, hirsutulo-pubescens; foliis oblongo-spathulatis planis membranaceis, imis tantum in petiolum attenuatis; pedunculis calyce brevioribus sæpius brevissimis; corolla calyce duplo longiore; capsula oblonga. — "California" [perhaps Arizona], Coulter, no. 463. Nazas Valley, Bolson de Mapimi, Chihuahua, Mexico, Gregg. It much resembles *N. dichotoma;* but is well distinguished by the more hirsute pubescence without viscidity, the larger corolla (about five lines long), and especially by the seeds.

++ ++ Semina ⅓ – ½-lineam longa, ovali-oblonga, favosa.

N. DICHOTOMA, Ruiz & Pav.; Gray, l. c. Pube brevi plus minus viscosa, corolla calycem haud vel parum superante, capsula ovato-seu breviuscule oblonga, seminibus grosse insculptis, distincta. — Mexico to Bolivia. — Var. ANGUSTIFOLIA: foliis lineari-lanceolatis. (Var. *pauciflora*, Choisy?) New Mexico, Fendler, no. 644, also Wright, no. 1584. "Colorado," Hayden. — The seeds in this widely diffused species are well marked, being so coarsely pitted that five or six pits fill the whole girth; and the thick obtuse edges of, or elevated portions between, the pits appear likewise to be minutely rugose under a strong lens.

+- +- Folia omnia graciliter petiolata: semina fere lævia.

N. LATIFOLIA, n. sp. Erecta, laxe ramosa, parce tenuiter hirsutula; foliis membranaceis ovatis obtusis basi sæpius cuneatis (lin. 6 – 9 et petiolo lin. 3 – 5 longis); pedunculis flore parvo longioribus; sepalis apice insigniter dilatatis corollam (albam) adæquantibus capsula brevi-ovoideo longioribus; seminibus globoso-ovoideis, areolis obsoletis. *N.? rupincola*, Mart. & Gal. ex Walp. Repert. 6, p. 565. — Mexico, Oaxaca, in fields and forests of the western Cordilleras, at the altitude of about 8,000 feet, coll. Galeotti, no. 1068. Valley of Mexico, coll. Bourgeau, no. 610.

* * * Perennes? forte annuæ caulibus diffusis basi lignescenti-induratis, pube mollissima: folia parva, cum petiolo brevi semi-pollicaria vel minora: sepala sursum latiora: semina minima.

N. RUPICOLA, Bonpl. ex Chois. l. c. Depressa, pube brevi vix cinerea; foliis obovatis in petiolum marginatum sensim attenuatis; seminibus subglobosis grosse parceque alveolatis. *N. origanifolia*, Gray, l. c., non HBK. *N. dichotoma* var. *parvifolia*, Torr. Mex. Bound. p. 147. Northern borders of Mexico to Yucatan (Schott) and Peru?

N. ORIGANIFOLIA, HBK. Nov. Gen. & spec. 3, p. 130, t. 218. Cinereo-villosa, subincana; foliis oblongo-spathulatis ovalibusque petiolo distincto; pedunculis sparsis calyce longioribus; seminibus lævibus? . . . . — Mexico. The principal specimens I have seen (Sierra Madre, Seemann) seem distinct enough from the foregoing, which, however, Kunth's figure too much resembles. He figures, but does not describe, the seeds as smooth.

* * * * Perennes, proceriores basi suffruticosa, foliis floribusque majoribus, pube hispida vel sericeo-canescente. Semina in *N. hirsuta* ut videtur compressa? in cæteris ignota.

+ Mexicanæ; foliis latis penninerviis basi sæpius obtusa distincte petiolatis, floribus in cymula laxa terminali nuda: sepala sursum latiora.

N. HIRSUTA, Martens & Galeotti; Walp. Repert. l. c. Fere hispida; foliis viridibus oblongis; corolla haud ultra semipollicari. — Oaxaca, Galeotti.

N. SERICEA, Willd.: Rœm. & Schutt. Syst. 6, p. 189. Sericea; foliis ovatis seu ovato-lanceolatis subtus incanis; corolla subpollicari. *N. longiflora*, Chois. l. c. t. 2, f. 2. I have it only in the collection of Coulter, no. 914, 915.

+ + Californicæ, lana araneosa; foliis lanceolatis basi sensim attenuatis vix petiolatis, floribus in glomerulos sessiles axillares et terminales confertis: sepala angusta sursum haud latiora.

N. LOBBII, Gray in Proceed. Am. Acad. 6, p. 37. Sierra Nevada, Lobb, Mrs. Davis, Kellogg.

N. systyla, Gray, l. c., is *Draperia systyla*, Torr. in Proceed. Am. Acad. 7, p. 401.

LYCOPUS, L.

In the last edition of the Manual of Botany, I was induced to consider all the American *Lycopi* with acute-pointed calyx-teeth as forms of *L. Europæus.* Having now had occasion to study them anew, I see grounds for a different opinion, and for disposing our species as follows: —

§ 1. *Stoloniferæ,* — stolonibus filiformibus elongatis apice demum tuberiferis.

* Calycis dentes 4, raro 5, cum bracteis brevissimis obtusi vel obtusiusculi, fructiferi nuculis breviores.

1. L. VIRGINICUS, L. — Forma depauperata: *L. uniflorus* Michx. *L. pumilus* Vahl. — Forma procera, var. MACROPHYLLUS: *L. macrophyllus,* Benth.

* * Calycis dentes 5, acutissimi, nuculis longiores.

+ Bracteæ minimæ: corolla calyce fere duplo longior: stamina rudimentaria brevissima, ovalia seu linguæformia.

L. SESSILIFOLIUS, n. sp. Glaber; caulibus adscendentibus humilibus acutiuscule 4-angulatis; foliis omnibus arcte sessilibus ovatis lan-

ceolato-oblongisve parcius argute serratis; calycis dentibus subulatis rigidis. — *L. Europæus* var. *sessilifolius*, Gray, Man. ed. 5, p. 345. — Pine Barrens of New Jersey, at Atsion, Canby, and Toms River, C. F. Parker, September.

L. RUBELLUS, Mœnch. Suppl. (1802). Subglaber; caule laxo suberecto 1–2-pedali, angulis obtusiusculis; foliis ovato-oblongis seu oblongo-lanceolatis medio argute serratis utrinque attenuatis acuminatis petiolatis; calycis dentibus triangulato-subulatis haud rigidis. — Fresenius in Flora, 1842; Benth. in DC. *L. obtusifolius* Vahl? non Benth.: but if so a depauperate form, and probably not from Hudson's Bay: the indications of habitat in the plants of Michaux's collection are not always correct. *L. Europæus*, var. *integrifolius*, Gray, Man. *L. Arkansanus*, Fresenius, l. c.; a puberulent form, with rather broader and less pointed calyx-teeth, the rudiments of sterile stamens varying from lingulate to linear-spatulate. — Pennsylvania? and Ohio to South Carolina, Louisiana, and Arkansas.

+ + Bracteæ exteriores acutissimi flores sæpius adæquantes: corolla calycem vix superans: stamina rudimentaria filiformia, apice capitellata vel clavellata.

L. LUCIDUS, Turcz. Caule valido 2–3-pedali erecto superne acutangulo; foliis lanceolatis vel oblongo-lanceolatis (poll. 2– 4 longis) acutis vel acuminatis grosse argutissime serratis basi obtusa nunc acuta subsessilibus; calycis dentibus attenuato-subulatis.

Var. AMERICANUS: foliis vix lucidis utrinque sæpius hirtello-puberis; caule plerumque hirsutiori; calycis dentibus minus rigidis. *L. obtusifolius*, Benth. in DC., vix Vahl. — Saskatchawan (Bourgeau, &c.) to Nebraska and Kansas, Fendler, E. Hall. Our plant clearly is not to be separated from the *L. lucidus* of N. E. Asia, which, again, too much resembles *L. australis*, in which also the dots of the leaves are unusually large.

§ 2. *Estolonosæ*, sed rhizomatibus pl. m. repentibus: dentes calycis 5, acutissimi, rigidi, corollam subæquantes, fructiferi nuculis longiores: bracteæ subulatæ, nonnullæ flores adæquantes. Glabræ vel pubescentes, caulibus acute tetragonis, foliis sæpius incisis vel pinnatifidis.

L. SINUATUS, Ell. Caule acutissime tetragono; foliis lanceolatis vel oblongis acuminatis irregulariter incisis et laciniato-pinnatifidis summisve sinuato-dentatis basi attenuatis in petiolum longiusculum; calycis

dentibus triangulari-subulatis brevi-cuspidatis; staminibus rudimentariis filiformibus apice capitellatis seu clavellatis. *L. sinuatus, exaltatus,* & *angustifolius,* Ell. *L. vulgaris* & *angustifolius,* Nutt. Gen., sine char. *L. Europæus* (Walt. &c.), var. *sinuatus,* Gray, Man. l. c. — From Canada to Oregon, California, and Florida.

L. Europæus, L. Caule acutiuscule tetragono; foliis latioribus subsessilibus, dentibus lobisve subæqualibus; calycis dentibus subulato-spinulosis; staminibus rudimentariis obsoletis vel nullis. — Collected long ago by Mr. Elias Durand near Norfolk, Virginia, where it was said to abound; recently detected on Petty's Island, near Philadelphia, by C. F. Parker, on waste ballast: adventive from Europe, and probably not established.

SESELI, L.

It is on the whole remarkable that so many of the leading genera of *Umbelliferæ* in the northern parts of the Old World should be without representatives in North America. Some of these gaps may be filled when the botany of our Western regions comes to be more completely investigated; as one appears to be now by the two species of *Seseli* here characterized.

The first of these plants has been for several years known to me in a specimen collected by Nuttall, in flower only, and presented by the kind Mr. Durand. It is ticketed by Nuttall "*Cynomarathrum saxatile,*" but it is not published. The same plant, in fruit only, was gathered by Dr. Parry in 1867, in the mountains of the northeastern part of New Mexico. The second species is no. 221 of Hall and Harbour's collection in the skirts of the Rocky Mountains, in flower only, and therefore not hitherto determined. Dr. George Vasey, in going over the same ground in 1868 at a later season, had the good fortune to obtain specimens in fruit; it is no. 221 of his recently distributed collection.

S. Nuttallii, n. sp. Acaulescens, glabrum; foliis subternato-pinnatipartitis, segmentis linearibus subulato-mucronatis, majoribus dentibus lobisve 1–3 nunc instructis; scapo simplicissimo nudo folia haud superante; floribus ut videtur albis; fructu oblongo glaberrimo pedicello parum longiore dentibus calycis subulatis conspicuis coronato; vittis in pericarpio parum suberoso ad valleculas et hinc inde sub jugis tenuibus; seminis sectione transversa semicirculari subcrenata. — Rocky Mountains, Nuttall. On rocks, Huefano Mountains, New Mexico,

Parry, coll. 1867, no. 83. — A span high, from a thickish branching caudex. Involucre as long as the pedicels, in Nuttall's specimen whitish and as if somewhat petaloid, the leaflets lanceolate or linear and a little connate at the base. Rays of the umbel from three to six lines long, of the umbellets one or two lines long. Styles long. Fruit a line and a half or two lines in length, the jugæ rather salient.

S. Hallii, n. sp. Acaulescens, glabrum; foliis pinnatisectis 3–5-jugis, segmentis cuneatis oblongisve incisis vel pinnatifidis, lobis 3–7 brevibus mucronatis nunc paucidentatis; scapo simplicissimo nudo folia superante; floribus flavis; fructu anguste oblongo glaberrimo pedicello brevissimo multo longiore; dentibus calycis brevibus demum evanidis; vittis ad valleculas magnis cum accessoriis sæpius in quoque jugo minimis; seminis sectione transversa subquadrata. — Low mountains of Colorado, Hall and Harbour; mentioned in Proceed. Acad. Philad., March, 1863, p. 63, no. 221. Bear Creek, seventeen miles west of Denver, Dr. George Vasey. — Scape ten inches high, slender. Umbel nearly as in the preceding, but the secondary rays are very short, as also are the ovate-subulate leaflets of the involucel. Styles slender. Fruit narrow, two lines long, abrupt both at the base and apex; the vittæ filling the intervals between the narrow and slightly salient jugæ. The odor of the fruit in both species is rather strong. Notwithstanding the yellow flowers of this species and the slender styles in both, they are confidently referred to *Seseli*.

Miscellaneous Specific Characters, &c.

Viola renifolia, n. sp. Rhizomate floribusque *V. blandæ* vel paullo majore; foliis reniformibus (adultis sæpius poll. 2 latis) utrinque cum petiolo villoso-pubescentibus; scapo pubescente. — This Violet was first brought to my notice by Miss Shattuck of Mount Holyoke Seminary, who collected it at, or received it from, "East Elba, New York." Later Mr. Henry Gillman sent it from Ontonagon, Lake Superior; and now I have fresh specimens and the living plant from Mr. Frank A. Sherman, of Hanover, New Hampshire. Also specimens from the colder parts of Oneida Co., New York, from Professor Paine. It grows in company with *V. blanda*, which it closely resembles as to the flower, but the leaves are more like those of *V. palustris;* yet they are more strictly reniform, and are conspicuously beset with pale, soft and tender, lax hairs.

ABUTILON PALMERI, n. sp. Fruticosum; foliis sinu profundo clauso rotundato-cordatatis denticulatis brevi-acuminatis (nonnullis obsolete trilobis) utrinque albido-velutinis; petiolis ramisque molliter puberulis; pedunculis infimis petiolo longioribus: calyce pedicello capsulaque 8-carpellari molliter villosissimo, carpellis membranaceis 3–4-spermis breviter acuminato-rostratis. — Yaqui River, Sonora, Mexico, Dr. E. Palmer. Leaves in the specimens not over two inches in diameter. Corolla orange-yellow, more than an inch in diameter. Seeds in one row, nearly glabrous.

KOSTELETZKYA DIGITATA, n. sp. Minutissime stellulato-pubescens cum stellulis adpressis majoribus; ramis paniculatis; foliis 3–5-partitis, petiolo setoso-hispido, segmentis cum foliis simplicibus ramulorum lineari-lanceolatis denticulatis subtus setis triradiatis conspersis; pedunculis unifloris gracilibus; calyce tantum puberulo; capsula 5-carinata ad suturas setosa; seminibus glabris. — Yaqui River, Sonora, Mexico, Dr. E. Palmer, 1869. Corolla little over half an inch in diameter, in the dried specimens purplish with a yellow eye.

DESMODIUM ILLINOENSE, n. sp. *D. canescentem* foliis floribusque, *D. rigidum* racemo et fructu referens; caule erecto 3–5-pedali cum foliis pube brevi hirsutulo; foliolis ovatis oblongis seu ovato-lanceolatis obtusis (poll. 2–4 longis) subcoriaceis subtus cinereis venis venulisque prominulis eximie reticulatis, inferioribus petiolum subæquantibus; stipulis persistentibus (bracteisque caducis) ovato-lanceolatis sensim acuminatis striatis; racemo simplici; lomento brevissime stipitato vix ultrapollicari ad suturam utramque (infer. profundiorem) sinuato, articulis 3–5 ovalibus lineas 3 haud excedentibus. — Illinois, in dry ground, Vasey, Hall, Bebb, Bergen, Stewart, &c.; apparently common, but not yet detected beyond the limits of that State. Smaller specimens have been confounded with *D. rigidum*, and larger, without fruit, with *D. canescens;* but it is abundantly different from both.

ASTRAGALUS ARRECTUS, n. sp. *Oroboidei:* sesquipedalis, cinereo-pubescens; caule stricto sulcato; foliolis 12–15-jugis anguste oblongis retusis supra glabellis subtus pubescentibus; stipulis discretis scariosis; pedunculis elongatis cum spica laxiuscula 3–4-pollicaribus; floribus (semipollicaribus) in pedicello brevissimo adscendentibus; calyce campanulato nigricanti-puberulo, dentibus subulatis tubo dimidio brevioribus; corolla ut videtur alba fere recta; legumine arrecto coriaceo oblongo (subpollicari) recto cuspidato basi subito in stipitem calycem subæquantem contracto, ventre leviter carinato, dorso sulco lato profundo, intus bilocellato polyspermo. *A. leucophyllus?* Hook. Lond. Jour. Bot. 6. p. 211, non Torr. & Gray, Fl. — Kooskooskee River, coll. Geyer.

BRICKELLIA ATRACTYLOIDES, n. sp. Fruticosa, ramosissima, vix pedalis; ramulis foliosis puberulis monocephalis; foliis rigidissimis subalternis subsessilibus ovato-lanceolatis spinuloso-acuminatis paucidentatisque 3–5-nervibus, costis cum venis adscendentibus anastomosantibus prominulis, paginis conformibus scabrido-atomiferis; pedunculo 1–2-bracteolato capitulum multiflorum (semipollicare) bis terve excedente; involucri campanulati squamis pauciseriatis, exterioribus ovato- intimis lineari-lanceolatis, omnibus subito acuminatis; acheniis secus costas hirtellis; pappi setis circiter 20 tenuiter saltem inferne barbellulatis. — Utah, near the Rio Colorado, 1870, Dr. E. Palmer. — Leaves less than an inch long, coriaceous and rigid, tapering into a spinulose point and beset with a few rigid spinulose teeth. This species would naturally be associated with *B. spinulosa*, of Northern Mexico, but it has forty or more flowers in the head and a minutely barbellulate or above merely scabrous pappus.

LINOSYRIS SQUAMATA, n. sp. Fruticosa, glabrata, ramosissima; ramulis scopariis viridibus substriatis; foliis squamiformibus brevissimis (lin. 1–2 longis) lato-subulatis triangularibusque subadnatis; capitulis subracemosis vel solitariis ramulos terminantibus plurifloris; involucri squamis oblongis obtusissimis margine subscariosis laxis pauciseriatis et in bracteolas minores decrescentibus; corollæ limbo fere 5-partito tubo dimidio breviore, lobis patentissimis lanceolatis (nervo centrali percursis!); antheris basi subsagittatis; styli ramis appendice brevissimo obtuso superatis; achenio glaberrimo lævi subclavato pappo molli (corollæ tubum adæquante) dimidio breviore.

Var. BREWERI, gracilior, parcius squamata; capitulis paucioribus minus bracteolatis; pappo ut videtur fusco. — Low hills of the Sierra Santa Monica, Los Angeles Co., California, Professor Brewer. I had mistaken this for the male of a Sergiloid *Baccharis*.

Var. PALMERI, crebrius ramosa; squamis loco foliorum approximatis sub capitulis imbricatis involucrum longe bracteolantibus; pappo albo. — Desert of the Colorado, Arizona, 1870. Dr. E. Palmer. — The achenia, which are perfectly fertile, resemble those of a *Baccharis*. The mid-nerve to the lobes of the corolla and the somewhat sagittate base of the anthers are as in *Tetradymia;* the style is of the Asteroideous type. Heads four or five lines long. In Dr. Palmer's fine specimens the involucre is remarkably imbricate-bracteolated down for the quarter or third of an inch. Corolla bright yellow, its lobes a line and a half long.

LINOSYRIS SONORIENSIS, n. sp. Glabra, parum viscidula, ramosissima; ramulis gracillimis; foliis parvis filiformibus apice recurvo nunc fere hamato; capitulis laxe paniculatis; involucro 5–8-floro, squamis pauciusculis subcarinatis coriaceis margine scariosis apice obtuso fere herbaceis oblongis, exterioribus brevioribus ovatis; ramis styli appendice ovato-lanceolata obtusiuscula portionem stigmaticum parum excedente superatis; acheniis clavato-oblongis villosis. — District of the Yaqui River, in the Mexican province of Sonora, 1869, Dr. E. Palmer.

20. MELAMPODIUM CUPULATUM, n. sp. Hispidulum; caule erecto ramosissimo; foliis (inferioribus ignotis) ramealibus oblongo-lanceolatis integerrimis basi attenuatis vix petiolatis; pedunculis filiformibus subpaniculatis monocephalis; involucro gamophyllo crateriformi ebracteato 5-lobo, lobis lato-ovatis brevibus, squamis int. achenia involventibus rugoso-tuberculatis apice truncatis haud cucullatis clausis; ligulis aureis. — Mexican province of Sonora, Dr. E. Palmer. — Heads about as large as those of *M. cinereum*, DC., but the bright yellow rays smaller: scales of the involucre united to above the middle.

PALAFOXIA LEUCOPHYLLA, n. sp. *P. lineari* affinis ob corollæ faucem angustam cylindricam tubo proprio lobisque brevibus 2–3-plo longiorem; foliis brevibus (semi–subpollicaribus lato-linearibus obtusissimis utrinque canescenti-sericeis; involucro magis pubescente; pappo corolla incarnata subdimidio breviore, paleis 4 majoribus lineari-oblongis costa valida haud excurrente emarginatis, 4 alternis brevioribus spathulato-oblongis costa medio evanida. Achenia extima 2–4 pro pappo sæpius paleis paucis brevissimis corneis subconcretis coronata. — Carmen Island, Gulf of California. Involucre half an inch, achenia and corolla each four or five lines in length. The branching stem is said to be about ten feet high, with an indurated, perhaps woody base, and to flower through the season. — Cultivated in the Botanic Garden at Cambridge, it is obviously disposed to become shrubby.

PENTSTEMON PALMERI, Gray, in Proceed. Am. Acad. 7, p. 378: char. e pl. viva reformatus: Glaucescens, glaber, bipedalis; foliis crassiusculis, inferioribus spathulatis et ovato-lanceolatis argute denticulatis in petiolum marginatum angustatis, superioribus perfoliato-con natis sæpe integerrimis; panicula multiflora elongata virgata nuda; bracteis omnibus minimis subulatis; pedunculis 1–3-floris pedicellisve gracilibus; sepalis ovatis glabris; corolla albo-rosea (i. e. alba roseo suffusa) pollicari, fauce e tubo proprio brevi (lin. 3 longo) subito maxime ventricoso-ampliata limbo ringente duplo longiore, labiis latis, superiori bilobo, inferiore patentissimo basi intus parce barbato profunde 3-lobo, lobis æqualibus conformibus; filamento sterili ultra faucem exserto apice incurvo insigniter longe flavo-barbato. — Cultivated from seeds of uncertain source, probably from Utah. Corolla almost an inch broad across the spreading lips (anteriorly and posteriorly): lower lip 7–8 lines broad: a light reddish line runs up each lobe of the lower lip.

LYCIUM PALMERI, n. sp. Inerme? subpubescens; ramis gracilibus; foliis angusto-spathulatis (lin. 6–8 longis); floribus breviuscule pedicellatis tetrameris; calycis lobis lanceolatis obtusiusculis tubo suo campanulato parum longioribus, uno saltem paullo majore; corolla (lin. 5 longa) calycem tertia parte superante, lobis late ovalibus pubero-ciliolatis, tubo paullo brevioribus; filamentis ima basi intus lanosissimis; antheris oblongis. — Yaqui River, Sonora, Mexico, Dr. E. Palmer. This apparently belongs to the third section in my revision of the North American *Lycia*, in Proceed. Am. Acad. 6, p. 45. Corolla broad for its length, the expanded limb being about half an inch in diameter.

SALVIA PLATYCHEILA, n. sp. *Brachyanthearum*, aff. *S. laxæ:* herbacea (basi ignota), minutissime cinereo-puberula; foliis oblongis ovatisque utrinque obtusis obsolete crenato-serratis, petiolo tenui, floralibus lanceolatis deciduis; racemo breviusculo; verticillastris paucifloris; calyce puberulo recto; labiis ovatis æqualibus cæruleo tinctis mox ampliatis tubo infundibuliformi nervoso æquilongis, superiore integerrimo, inferiore apice bifido; corollæ cæruleæ tubo incluso; connectivo subcrasso glaberrimo; stylo superne hinc barbato. — Carmen Island, in the Gulf of California, Dr. E. Palmer, 1869. Corolla half an inch long; the upper lip hardly, the dilated lower lip somewhat, exceeding the calyx.

COLDENIA (TIQUILIOPSIS) PALMERI, n. sp.: pube brevi et brevissima densa molli incana; foliis ovatis crebre plicato-nervosis petiolum subæquantibus; calyce tubo corollæ dimidio breviore, lobis lanceolatis tubo ipso breviore. — S. E. California or Arizona, on the lower Colorado, Dr. Edward Palmer, 1869. Well distinguished from *C. Nuttallii*

by the fine hoariness and the absence of all hispid or even hirsute hairs, and by the calyx. It is apparently more erect and bushy. The corolla is similar but larger, and has roundish-oval lobes. No fruit was collected, by which to learn whether it accords with *Tiquiliopsis* in having two-parted cotyledons. The leaves are more like those of *C. fusca*, but the rib-like veins more numerous and crowded, from four to six pairs, and the surface in the younger specimens strongly and beautifully plicate. This has likewise been collected in Utah or Nevada by S. Watson, in Clarence King's expedition.

ERIOGONUM KELLOGII, n. sp. *Umbellata*, depressum, caudicibus ramisve sterilibus substoloniferis filiformibus late pulvinato-cæspitosum; foliis rosulatis spathulatis parvis (lin. 3 – 4-longis) basi angustata sessilibus sericeo-incanis (supra nunc glabrescentibus); scapo gracili tripollicari medium versus verticillo e foliis 3 – 4 parvis instructo involucro solitario cyathiformi 6 – 7-lobato terminato; perigoniis luteolis demum albidis roseo tinctis extus glaberrimis, stipite gracili, segmentis subconformibus ovalibus obovatisque intus basi cum parte inferiore filamentorum villosis; cotyledonibus late ovalibus excentricis radicula parum longioribus. — In fir-woods, forming tufted mats, Red Mountain, Mendocino County, California, Dr. A. Kellogg, July 1, 1869. Involucre silky-canescent. Perigonium two or in fruit nearly three lines long, not including the stipitiform base of fully half a line. Except that the perigonium is wholly glabrous exteriorly, this neat species would stand next to *E. Douglasii*: but the head and the leaves are smaller, and the flowers fewer: the whorl on the scape usually consists of only three bract-like leaves. The foliage is more like that of a condensed and alpine form of *E. cæspitosum.*

LASTARRIÆA CHILENSIS, Remy. In Proceed. Amer. Acad. 8, p. 199, where this is first recorded as a Californian plant, on the authority of a specimen collected by J. Blake, some doubt was expressed as to whether it was there indigenous. Since then I have been able to ascertain, through the kindness of Mr. Bennett, that a specimen in Nuttall's herbarium, now belonging to the British Museum, ticketed by Nuttall "*Ancistrophyllum Californicum*, Sta. Barbara" is *Lastarriæa Chilensis*, but taller and coarser than any of our Chilian specimens. A slender form of the same species was lately abundantly collected near the mouth of the San Joachin, by Dr. Kellogg, who informs me that it is common around San Francisco, "chiefly, if not entirely, where sheep and cattle frequent." So that its introduction into California by cattle, which is most probable, is not likely to have been recent.

POLYGONUM HARTWRIGHTII, n. sp. *Persicaria, Digyna;* strigoso-hirsutum vel glabellum; caule subpedali erecto striato ad apicem usque crebre æqualiter folioso; foliis lato-lanceolatis utrinque acutis vel obtusiusculis breviter petiolatis; ochreis medio foliigeris hypocraterimorphis, limbo foliaceo brevi reticulato repando setoso-ciliato; pedunculo erecto eglanduloso spicam plerumque solitariam densam cylindraceam gerente; bracteis pedicellos superantibus; perigonio eglanduloso roseo; staminibus 5; stylo profunde bifido. — Sedgy bogs, New York, from Herkimer to Yates County, and Michigan. — Fruit unknown. I collected this almost forty years ago at the head of Cayuga Lake, along with the remarkable *P. amphibium* var. *Muhlenbergii* of Meisner, which is widely distributed in North America. I saw it several years ago, in company with the Rev. Professor Paine, in a high bog near the southern borders of Herkimer County, but not in flower. I have also a well-developed specimen from the State collection in Michigan. Not regarding the stipules, it had been taken for one of the various puzzling terrestrial varieties of *P. amphibium*, or, when the stipules were noticed, for an undeveloped condition of *P. Careyi*. But my attention having been called to it by Dr. S. Hart Wright, of Penn Yan, who finds it in open bottom land, among Carices, at Dundee, Yates Co., New York, I am desirous that it should bear his name, as the real discoverer of its specific characters.

ARGYROTHAMNIA (DITAXIS) ADENOPHORA, n. sp. Herbaceum, molliter puberulum; foliis oblongo-linearibus basi trinervatis subdenticulatis, superioribus cum petiolis bracteis calyceque fœmineo saltem ad margines glandulis claviformibus luteolis obsitis; floribus monoicis; petalis oblongo-lanceolatis integris calycem subsuperantibus, fl. masc. glabris, fl. fœm. extus pilosulis; filamentis columnæ 15 quorum 10 antheriferis; ovario setoso; seminibus obovatis rugoso-foveolatis. — Sonora, Mexico, Dr. E. Palmer.

Appendix: December, 1870.

CONRADINA, Nov. Gen. *Labiatarum.*

Calyx fere *Calaminthæ*, 13-nervius, oblongo-campanulatus, subteres, bilabiatus; labio superiore lato subpatente tridentato; inferiore erecto bipartito, dentibus subulatis longioribus. Corolla exannulata, ad summum tubum angustum rectum calyci subæquilongum retroflexa, profunde bilabiata, ringens; fauce brevi ampliata; labio superiore sub-incurvo retuso; inferiore patentissimo basi contracto trilobo, lobis lateralibus rotundatis, medio latiore emarginato-subbilobo. Stamina 4, inferioribus paullo longioribus didynama, sub labio superiore incurvo-adscendens, fere parallela: antheræ muticæ, biloculares; loculis subparallelis connectivo transversim dilatato demum sejunctis basi fasciculo pilorum instructis. Stylus glaber, cruris subulatis æqualibus. Nuculæ læves, globosæ. — Suffrutex *Rosmarini* facie, ramosissimus, tenuiter canescens, foliosissimus; foliis angusto-linearibus margine revolutis, in axillis nunc fasciculatis; cymulis 2 – 7-floris laxis in axillis subsessilibus; corolla albo-purpurea extus pubescente; calyce fructifero declinato, dentibus (rarius tubo) pilis patentissimis hirsutis.

CONRADINA CANESCENS. *Calamintha canescens*, Torr. & Gray ex Benth. in DC. Prodr. 12, p. 229, & Chapm. Fl. p. 318. — Dry sands along the beach and in pine woods of Western Florida, from Appalachicola to Pensacola and Mobile: called "Wild Rosemary." — A well-marked genus in habit and character, much better distinguished from *Calamintha* than is *Melissa*, in foliage, inflorescence, &c., not unlike *Dicerandra*. The essential character is in the corolla, which is widely ringent, and abruptly bent backwards on its tube.

The genus is dedicated to the memory of Solomon W. Conrad, the associate of Muhlenberg and the other Pennsylvanian botanists of the last generation, the publisher of Muhlenberg's Catalogue and his Descriptio Uberior Graminum, &c., — himself a botanist of no mean acquirements. Long ago the Gerardineous genus which now bears the name of *Macranthera*, Torr., was dedicated to Mr. Conrad by Nuttall (in Jour. Acad. Philad. 7, p. 88); but the earlier-published Gesneriaceous *Conradia* of Martius, in memory of Conrad Gesner, retains this name. By means of a moderate change in the orthography, we may arrange to connect the name of our American *Conrad* with this striking plant of our own country.

POLIOMINTHA, Nov. Gen. *Labiatarum*.

Calyx tubulosus, 13 – 15-nervius, striatus, æqualis, dentibus 5 æqualibus, fauce annulato-villosa. Corolla tubo recto pl. m. exserto, intus piloso-annulato; limbo breviter bilabiato; labio superiore erecto subplano emarginato; inferiore trifido patente, lobo medio emarginato-bilobo. Stamina fertilia 2 (inferiora), parallele adscendentia, apice nunc incurva, antheræ loculis divaricatis: filamenta 2 superiora sterilia brevissima. Styli cruri subinæquales. Nuculæ læves. — Suffrutices incani; foliis integerrimis parvulis; floribus in axillis paucis fasciculatis vel solitariis; corolla ut videtur rosea.

The name, composed of the Greek words for hoary-white, or gray and Mint, is suggested by the silvery canescence. The typical species has been described as a *Hedeoma* by Dr. Torrey, but with a natural misgiving, on account of the habit, the perfectly regular and equally toothed calyx, and the villosity in the throat of the corolla. This forms, indeed, a definite and nearly if not wholly complete ring, which is a character thought to be of some moment in Labiatæ. I am disposed to join with it a species collected by the late Dr. Gregg in Northern Mexico, which has a much elongated corolla in the manner of *Calamintha coccinea*, and which would technically belong to *Keithia* except for the obvious rudiments of the upper pair of stamens, and the pilose ring, which is here close to the base of the tube of the corolla. *Keithia marifolia*, Schauer, in Linnæa, 20, p. 705, from the same region, may probably be added to this genus, at least if no. 1080 of Coulter's Mexican collection is of that species: for in Coulter's plant the rudiments of the upper pair of stamens (of which in Aschenborn's plant there is said to be "*nullum vestigium*") are conspicuous, and even with vestiges of the abortive anther. But no trace of the pilose ring is found.

Poliomintha incana. Ramis gracilibus cum foliis linearibus (imisve oblongis) planis obtusis pube brevissima creberrima canescentibus; verticillastris paucifloris; pedicellis brevissimis; calyce breviter tubuloso 15-nervi villosissimo; tubo corollæ parum exserto, fauce ampliata intus piloso-annulata. *Hedeoma incana* Torr. Bot. Mex. Bound. p. 130. — New Mexico, near El Paso, &c., Parry, Wright, Bigelow, Palmer. — Corolla only twice the length of the calyx.

Poliomintha longiflora, n. sp. Pube molli laxiori; foliis ovalibus vel obovatis (cum petiolo brevi lin. 4–6 longis) supra viridulis subtus cano-tomentosis subvenosis; pedunculis in axillis solitariis brevibus unifloris bibracteolatis; calyce elongato (subsemipollicari) vix striato 13-nervi; corolla tubulosa sursum sensim paulloque ampliata longe exserta extus piloso-pubescente, labiis brevibus, annulo prope basim; staminibus styloque exsertis. — Northern part of Mexico (station unknown), Dr. Gregg, 1848–1849. — Corolla an inch and a half long.

Six hundred and twenty-third Meeting.

September 13, 1870. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Messrs. Newcomb, Safford, H. J. Clark, and Merivale, acknowledging their election by the Academy.

The President stated that when abroad he procured a complete set of the Proceedings of the Cambridge Philosophical Society; after a delay of nearly a year, they had not yet come to hand, but he still hoped to recover them. He also called attention to a copy of the Greek Dictionary of Professor Sophocles, in which the author acknowledged his indebtedness to the Academy in the following note: — "The greater part of the Author's Glossary of Later and Byzantine Greek, forming Vol. VII. (new series) of the memoirs of the American Academy, has been incorporated in the present book."

Professor Benjamin Peirce referred to the appropriation recently made by Congress to observe the eclipse next December, and stated that the full number of observers had not yet been obtained. As the English government has withdrawn the vessel offered to the Royal Society, it becomes the more necessary that great efforts should be made to render the American expedition a success.

Mr. W. H. Dall referred to the expedition organized in 1865 to explore the route for the International Telegraph line between the mouth of the Amoor River and some point in the United States territory.

To this expedition a scientific corps was attached, under the leadership of the late lamented Robert Kennicott. The special problems to be solved were those of the boundary of the water-shed of the extreme northwest portion of the continent, and the distribution of animal life in the same region. The result of these explorations showed that the great *Yukon* River of the Hudson Bay territory was identical with the *Kwichpak* of the Russians, and debouched into Bering Sea, south of Norton Sound; that the Rocky Mountains, instead of being prolonged in a nearly straight line northward to the Arctic Sea, were really bent to the northwest about latitude 65°, and, trending with the coast, formed, with another volcanic series of mountains, the backbone of the Alaskan Peninsula and the Aleutian Islands. Instead of a confused mixture of eastern, western, and Asiatic forms in the bird-fauna, it was discovered that the latter was mostly composed of Eastern and Canadian forms, which passed westward north of the mountain wall of the Alaskan Range, and, throwing out the water-birds, contained very few representatives of the West American avi-fauna; fewer, indeed, in number, than those of the Eastern type, which encroached on the western district south of the mountains along the coast.

The distribution of the marine animals presented some phenomena of great interest not yet fully worked out or explained. The "line of floating ice" in Bering Sea passes between St. Matthew and the Pribyloff group of islands, and appears to form an invisible but very distinct line of demarcation, north of which the fur-seal, cod, and marine invertebrates, typical of the temperate west-coast fauna, do not pass; while the white bear, certain fish, and all the strictly arctic invertebrate marine forms, keep as constantly to the north as the others do to the south side of the line.

The glimpses thus obtained of a marine fauna of wonderful richness, and the great interest attaching to the deep-sea dredgings, inaugurated by the U. S. Coast Survey, and since carried on by Carpenter and Wallich, Jeffreys, Sars, MacAndrew, and others, have impressed me with a desire to attempt a further exploration of the marine fauna of these regions. They are of special interest, from the fact that the researches of Carpenter, Adams, MacAndrew, and Forbes have shown an identity of species common to our northwest coast, Japan, the Ægean Sea, and, finally, the Red Sea; and the phenomena revealed by the dredge have a very important bearing not only on the distribution of animals, but on geology and the serial succession of animal life in time.

I hardly feel justified at present in saying more than that I have strong hopes that such explorations will not long be delayed, and that they will probably be prosecuted in connection with a hydrographic survey of the little-known coasts and islands of that portion of the continent; a survey which will, if successful, bring forth results of interest and value not only to the naturalist, but to the physicist, geologist, and those engaged in purely commercial pursuits.

Remarks on this communication were made by the President and Professor B. Peirce.

Six hundred and twenty-fourth Meeting.

October 11, 1870. — MONTHLY MEETING.

The CORRESPONDING SECRETARY in the chair.

The Corresponding Secretary read a letter from the American Oriental Society, thanking the Academy for the use of their room.

Professor Joseph Winlock exhibited a contrivance for recording the position of lines in the spectrum, especially adapted to solar eclipses. A silver plate is attached to the telescope of a spectroscope, and a graver to its stand. By a simple motion the position of any line may be permanently recorded and afterwards measured. The principal lines of the solar spectrum are first recorded, the plate is then moved slightly backwards, and a number of spectra may be drawn on the same plate and compared with one another. Since the spider-lines may be invisible on account of the darkness, a break is made in the one which is vertical, and a spark from a Ruhmkorff coil passed through it, thus giving a bright spot of light. He proposed to apply this method of recording to determine the declination of a star in meridian instruments.

Mr. George W. Hill presented a paper on the determination of the mass of Jupiter from its effect on the asteroids. Those are selected whose time of revolution is nearly one half that of Jupiter, and the perturbation thus produced is one of the largest in the solar system.

Professor N. S. Shaler made a communication on the figure of the continents of Mars, compared with those of the earth. In both there is a tendency to point towards one pole,—those of Mars to the north, of the Earth to the south.

Remarks on this subject were made by Professors Lovering, Whitney, and Winlock.

Dr. E. H. Clark made a communication on hydrate of chloral, supplementary to one made by him three months or more ago. He stated that physiological experiments on man and the lower animals with this substance had shown it to possess a peculiar power over the living economy, and that chemical observation had confirmed the results of physiological experiment. The hydrate of chloral had already assumed a definite position in therapeutics. As a hypnotic it had been shown to be an agent *sui generis*. The sleep it produced resembled natural sleep very closely, and was unlike the sleep produced by opium, Indian hemp, alcohol, hyoscyamus, or any other known agent of the materia medica. Dr. Clark concluded his communication by some observations on the absorption and elimination of hydrate of chloral, and on its *modus operandi* while in the system.

Dr. Charles Pickering referred to Professor Sophocles's lexicon as a most valuable addition to the works of American scientists.

Dr. T. S. Hunt made some remarks on the Siemen's process of making cast steel, and called attention to the beautiful example it presents of the dissociation of gases.

Six hundred and twenty-fifth Meeting.

November 9, 1870. — STATED MEETING.

The PRESIDENT in the chair.

The President stated that it would be necessary for the society to elect a secretary to serve during the absence of Professor E. C. Pickering.

It was voted that Professor N. S. Shaler act as secretary *ad interim*.

The committee appointed to consider the disposition of the income from the Rumford Fund presented the following report, which was accepted.

The undersigned respectfully report on the questions referred to them: —

That the Rumford Fund was founded for the purpose of enlarging and diffusing knowledge concerning heat and light.

The decree of the S. J. Court respects this purpose perfectly; and only provides new methods for carrying it into effect.

The Academy may publish Rumford's works, and Professor Lovering's paper on the Aurora, and such other works or papers as may reasonably be considered promotive of the purpose of the fund.

They may give or exchange these publications in any way they think subservient to the same purpose.

They may sell the books. But in selling them they treat them as merchandise; and as merchandise they were paid for by the Rumford Fund and belong to that fund. And the money received for them should be credited to that fund.

A profit or advantage to the Academy seems not to have been in the mind of Rumford in creating the trust, nor in the intention of the Academy in accepting it; nor in the contemplation of the court in making their decree. It may be that the Academy would be permitted to charge the common commission for the care of property held in trust; but, beyond this, we think any profits arising from any employment or disposition of the fund, belong, not to the Academy, but to the fund.

[Signed] THEOPHILUS PARSONS.
NATHANIEL HOLMES.

NOVEMBER 3, 1870.

It was voted that the members of the Rumford Committee, together with the President, the Vice-President, and Secretaries of the society, act as a committee to determine the method to be adopted for the distribution of the Academy's edition of the works of Count Rumford, with power to act, and to report at the next stated meeting.

The Vice-President stated that it was very desirable that there should be a precise record made of the amount received from the sale of the works of Count Rumford, in view of the doubt concerning the disposition of the profits arising from such sale.

It was voted that the cost of publishing the memoir of Professor Lovering on the Periodicity of the Aurora be paid from the Rumford Fund, subject to the action of the Rumford Committee.

The committee appointed to consider the question of the amendment to the constitution concerning the annual assessment, reported in favor of the amendment.

It was voted that the amendment be enacted.

The following gentlemen were elected members of the Academy: —

G. Kirchhoff, of Berlin, to be a Foreign Honorary Member in Class I., Section 3, in place of the late Thomas Graham.

Kaulbach, of Munich, to be a Foreign Honorary Member in Class III., Section 4, in place of the late Overbeck.

Henry Carey Lea, of Philadelphia, to be an Associate Fellow in Class III., Section 3.

Professor E. J. Cutler, of Cambridge, to be a Resident Fellow in Class III., Section 2.

Professor E. J. Young, of Cambridge, to be a Resident Fellow in Class III., Section 2.

Professor C. C. Langdell, of Cambridge, to be a Resident Fellow in Class III., Section 1.

Six hundred and twenty-sixth Meeting.

December 13, 1870. — MONTHLY MEETING.

The PRESIDENT in the chair.

Professor J. D. Whitney read the first part of a communication on the fossil remains of man found in California.

Professor N. S. Shaler called attention to the fact that the circumstances connected with the occurrence of these remains beneath Table Mountain resembled, in a striking way, those of similar remains found near Le Puy in Haute-Loire, France.

Professor J. D. Whitney called attention to the discovery, by Mr. Clarence King, of glaciers in the northern slope of Mt. Shasta.

Mr. E. N. Horsford gave an account of the system of hydraulic mining in California.

Six hundred and twenty-seventh Meeting.

January 9, 1871. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President read a letter from Professor Kirchhoff, of

Berlin, acknowledging his election as Foreign Honorary Member.

The President announced the death of Professor E. J. Cutler, Resident Fellow of the Academy.

Professor J. D. Whitney continued the reading of his paper on the remains of pre-historic man in California, left unfinished at the last meeting.

The following communication on the Tides, by Lieutenant Roumiantzoff, was read.

In the note "sur la theorie des marées" (*Comptes Rendus*, May 16, 1870) I defined the phenomena of tidal vibrations. The view I take on the subject is simply a development of the general idea expressed by Laplace in his *Mécanique Céleste.* Laplace in fact established that: —

a. The phenomena of tides consist in the movements of fluid;

b. The infinitely small motion of particles of water is possible only on the surface of their level;

c. The fluctuation of level on the coast is secondary in respect of oceanic motion.

At this time the physical description of the phenomena was very insufficient, and the local circumstances on which the tides depended were unknown; consequently Laplace could not follow out the true principles of his theory, and arrived in his final results at an assumption of a certain proportionality between the phenomena of tides and the disturbing forces. (*Vide* Laplace, *Mécanique Céleste*, Tome V. Chapitre XIII.)

At the present time many of the peculiarities of the tides have been shown by observers, and the principles which were wanting have been mentioned in the remarkable works on "Tides" by the Astronomer-Royal, Mr. Airy, Dr. Whewell, and others. These investigations have caused the fundamental idea in Laplace's theory to be lost sight of; so that until the present time the phenomena of tidal motion have been examined as the disturbance of the form of waters in the ocean under the influence of attracting bodies. At sea-stations we observe not the form of the free surface of waters surrounding the solid globe, but the result of the small horizontal vibrations of the particles of the ocean waters; and thus the investigation of the equations of the surfaces of the ocean level does not include the theory of tides. Such an explanation is in visible contradiction with the remarkable theory of "waves," by Mr. Airy, the works of Whewell, and others; but I will immediately show that it would be highly important to apply the solutions given in these works to the explanation given in my former notice. There I particularly endeavored to explain the origin of tidal currents of great rate, and then I said, in short, that we should have to investigate the propagation of tidal currents in bays. Mr. Whewell, in his numerous works, having acquainted us with the geography of the phenomena, and shown many details, as well as many empirical laws of the tides, avails himself also of the idea of "cotidal lines" in explaining the peculiarities of the tides. As is well known, the cotidal lines are curves drawn through the points of simultaneous high waters; their position on the map is associated with the idea of the propagation of tidal motion. The phenomena of tides in the ocean being fully determined by the theory, it is evidently impossible to draw the cotidal lines across the ocean, in the same way as the question is impossible, — "Whether high or low water will occur at the transit of an attracting body." It would be highly important to make use of the theory of cotidal lines to explain the propagation of tidal currents, in which case the cotidal lines will be the direct expression of the physical law. The cotidal lines connecting the points, at which the greatest velocity of tidal currents is being simultaneously observed, are necessary for the study of tidal phenomena in large bays (as e. g. White Sea and German Ocean). Notwithstanding this, the explanation of the phenomena is still very difficult when they occur in rivers, and where the tide rises gradually; whereas the superficial currents are very irregular and slack. In these cases, starting from the theory developed by Mr. Airy in his work "Tides and Waves," we arrive at the laws of the phenomena. If, in fact, the pressure of the ocean in its progress meets with great resistance in the system of waters in a quiescent state, or running in the opposite direction, then the propagation of this pressure will be observed as taking place in the form of waves (positive).

The general description of the phenomena of tides was given by me in the more simple case when the bay is immediately connected with the ocean. The observations of tidal currents made by many eminent American, English, and French observers, and also the full investigation of tidal currents in the White Sea by the Russian hydrographer, Risnecke, have been taken by me as authorities. From the foregoing remarks we can infer how complicated the phenomena will be in many cases; in each instance of this kind a separate physical description will be indispensable, as the local circumstances are sometimes very different. The most simple case for the investigation of the laws of tidal currents is afforded by observations made on shoals at a great distance from the coast. Thus observations on the shoals of the German oceans, of the Sooloo Sea, and others, do not show the existence of any noticeable rise of level. Let us suppose a shoal in the middle of the ocean, the depth of the ocean to be 20,000 feet, and 20 feet on the shoal, then the velocity of waters on the shoal could not exceed the rate of the ocean motion more than one thousand times. In any case, the velocity of the current on this shoal will not be great, as the ocean motion is too slow; besides, the velocity of tidal currents increases gradually from nothing, and if the shoal is of small superficial dimensions, then the resistance to the progress of tidal motion will be insignificant, and observations will not show any rise of level. I will here add an explanation why tides are not strong at the islands of the open ocean, but attain great dimensions in bays and narrows along the coast of the continent. In the former case, the lesser mass of the ocean waters helps to communicate a progressive motion to the particles of water; whereas, in the latter case, all the mass of the ocean presses on the coast of the continent, and the running waters being reflected from the promontories and straight shore convey their *vis viva* to the waters of the bays and narrows which indent the shore of the continent.

I subjoin the following remarks to the conclusions made by me in the first note:—

1. The Astronomer-Royal, Mr. Airy, in his works on the tides, more than once points to the inadequacy of all the theories of the tides (see e. g. Airy, "Tides and Waves," Section II., No. 14); thus in the first conclusion I explain the results given by Mr. Airy.

2. The time and the magnitude of the greatest velocity of tidal currents are opposed by me to the generally admitted rule of investigating the laws of times and heights of high water. According to the theory of tidal motion, the velocity of the current may be given by the function of the disturbing forces, whereas the rise of level will be a very complex function of currents, which only can be expressed by an empirical formula, because many of the local circumstances cannot be analytically stated.

3. The law of the revolving direction of tidal currents (from E. round by N. in north lat. and from E. round by S. in south lat.) is

confirmed by all observations made in points open to the ocean. In contracted estuaries and along the shore the currents follow the shore line. In some points of a complicated and large bay a change in the reverse direction is sometimes observed, as these points are reached by the currents after many reflections from the shore.

4. The relation of the rise of the tide to the velocity of the flow solely depends upon local circumstances. If the shore extends perpendicularly to the direction of the flow at its greatest rate, then high water occurs soon after the time of maximum of velocity. In bays stretching considerably inland, when the velocity is small and the rise depends on the mass of water remaining in, the time of high water occurs considerably later than the time of greatest velocity of the current from the ocean. This delay becomes an essential element in the theory of tides, for it determines the time and height of high water, and upon it depends the retard of the spring and neap tides after the days of syzygy and quadrature.

5. The first part of the *establishment* is drawn from the theory; the second, with the magnitude of the greatest velocity of flow, determines the influence of local circumstances.

6. The absence of full uniformity in the mean level immediately proves that the height of the lunisolar tides is not equal to the algebraical addition of the lunar and solar tides (one of the evident inferences of theory of tidal motion). In fact, Mr. Airy deduced from the observations "that the mean level is higher in the large tides than in the small ones." ("Tides and Waves," p. 374. . . . . "The mean level at Sheerness is higher in spring tide than in the neap tide by seven inches nearly." . . . . And I inferred from this that the lunisolar tide is greater than the addition of solar and lunar tides at Sheerness by about fourteen inches.) This inequality might be considerable; but the various resistances to tidal motion on the coast reduce the large tides far more than the small tides. Proceeding from the observations made in Ireland, Mr. Airy alluded to the difference of the mean height of the sea round the island. The definition of the normal level on the coast is immediately deduced from my explanation of the phenomena of tides. In some points of a complicated large bay, the level of low water at spring tide may be higher than the ocean level (in case of a constant movement of the waters); but the level in the bay during a quiescent state of waters (as observed at low water) will never fall lower than the ocean level. The small motion of the

particles of the ocean waters from the shore will be followed by a similarly small fluctuation of the level along the coast.

The observations of the rise of the tide give us the result of the effect of all the causes without the possibility of distinguishing the power of each of them separately. In fact, the elevation of the level corresponds to each periodical current from the ocean; thus, to explain some inequalities of the heights of tides, we must consider the causes from which the periodical currents may proceed. For instance, the diurnal inequality of heights is observed in all morning and evening tides, which undergoes a periodical change according to the season of the year. But, on the other hand, the difference between the heating of the waters by the sun along the shore (where the diurnal amplitudes in the temperature are very considerable) and in the ocean will cause the periodical currents. Certain other inequalities in the heights of tides will also proceed from the periodical and accidental variations in the direction and rate of the constant local currents. The power of the wind to drive the waters into the bays increases the height of the level. The anomalies in the phenomena of tides are explained by the interferences of the currents, and by the streams caused by the difference of the level in the nearest points.

Six hundred and twenty-eighth Meeting.

January 25, 1871. — STATED MEETING.

The PRESIDENT in the chair.

There being no quorum for the transaction of business, the matters which should have been acted upon at this meeting were postponed.

The President announced the death of Professor William Chauvenet, Associate Fellow of the Academy.

Professor N. S. Shaler made a communication on the Geology of the region about Richmond, Va. He claimed that the sienite ridge which occurs at that point was of later elevation than the rest of the Appalachian Ridge, which it clearly resembled in many important regards; furthermore, that the salient angle of Cape Hatteras was caused by the elevation of this ridge. Mr. Shaler also claimed that the Cincinnati axis of elevation was the first of the Appalachian system, having been elevated during the Lower Silurian epoch.

Voted to adjourn this meeting to the second Tuesday in February.

Six hundred and twenty-ninth Meeting.

February 14, 1871. — ADJOURNED STATED MEETING.

The Academy met at the house of Dr. H. W. Williams.

The PRESIDENT in the chair.

The following gentlemen were elected Fellows of the Academy: —

Charles Francis Adams, Jr., of Boston, to be a Resident Fellow in Class III., Section 3.

Professor C. C. Everett, of Cambridge, to be a Resident Fellow in Class III., Section 1.

William Everett, of Cambridge, to be a Resident Fellow in Class III., Section 2.

Henry W. Paine, of Cambridge, to be a Resident Fellow in Class III., Section 1.

John G. Whittier, of Amesbury, to be a Resident Fellow in Class III., Section 4.

Ferdinand Bôcher, of Cambridge, to be a Resident Fellow in Class III., Section 4.

George J. Brush, of New Haven, to be an Associate Fellow in Class II., Section 1.

Stephen T. Olney, of Providence, to be an Associate Fellow in Class II., Section 2.

Jeremiah Smith, of Dover, N. H., to be an Associate Fellow in Class III., Section 1.

In accordance with the recommendation of the Rumford Committee, it was voted: —

That the cost of printing the memoir of Professor Joseph Lovering, on the *Periodicity of the Aurora Borealis*, be assessed on the income of the Rumford Fund.

Also, that one hundred copies of the quarto edition of the

Life of Rumford be presented to Dr. George E. Ellis, together with a complete set of the Essays (as edited by the Committee), with the thanks of the Academy.

It was voted that the Finance Committee be requested to prepare a statement of the current expenses and receipts of the Academy.

It was voted that the meeting adjourn, at its close, to the second Tuesday in March.

Professor Pickering made a communication on a new form of solar eyepiece, by which the light may be reduced to any desired extent.

In the common diagonal eyepiece all the light is reflected into the eye by the inclined surface of the prism. A second prism is connected to the first by some substance whose index of refraction is very nearly equal to that of the glass. In consequence, an exceedingly small proportion of the light is reflected, the greater part passing directly through, out of the telescope. Again, since the angle of incidence equals 45°, the reflected ray is almost totally polarized, and its intensity may be varied at will by a Nicol's prism. Colored glasses are thus avoided, and with them the danger of heating and cracking the lenses of the eyepiece, as almost all the heat and light passes out of the tube. If desired, it may be received on a second eyepiece or spectroscope, so that during an eclipse or transit, for instance, two observers may use the same telescope. A curious coloration of the images is sometimes produced, probably due to the unequal dispersion of the glass and cement. Apart from its practical application, this device has a scientific interest as affording a means of producing a plane reflecting surface whose index of refraction is very nearly unity.

Professor J. D. Whitney read several affidavits of the discovery of pre-historic man in Colorado.

Professor N. S. Shaler made a communication on the formation of continents. He compared the circular development in the Moon with the linear development in the Earth and Mars.

Professor J. D. Whitney read letters from Baron Richtofen on the geology of China and Japan. He also exhibited a new method of illustrating books.

Remarks on this communication were made by the President, Mr. T. T. Bouvé, and Professor N. S. Shaler.

Dr. H. W. Williams showed a new test for astigmatism.

Six hundred and thirtieth Meeting.

March 24, 1871. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

The President presented the report of the Committee on Finance.

The Corresponding Secretary read letters from Messrs. Olney, Whittier, Brush, and Kaulbach, accepting membership of the Academy.

It was voted to appropriate the additional sum of $500, to be expended by the Committee of Publication.

It was voted that the annual assessment be raised from five dollars to eight dollars.

Professor B. Peirce made a communication on the recent eclipse, in which he called attention to the indebtedness of the English observers to the plans of the Americans, and their omission of a suitable acknowledgment. His own observations were conducted in Sicily, where he divided his party into five sections, of which two had clear weather. All the observations tended to show the solar nature of the corona.

Remarks on this communication were made by Professor E. C. Pickering.

Six hundred and thirty-first Meeting.

April 11, 1871. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from Professor Ferdinand Bôcher acknowledging his election into the Academy.

Professor J. P. Cooke presented a report of the Rumford Committee on the cost of publication of the Life and Works of Count Rumford.

Remarks on this report were made by the President, Messrs. Quincy, Lovering, Lyman, J. C. Gray, J. I. Bowditch, and Shaler.

A motion to suspend the publication of the second volume of Count Rumford's Works was laid on the table, and the report was referred back to the Rumford Committee.

Professor Joseph Winlock exhibited some pictures of the eclipse of 1870, and pointed out the resemblance between the photographs of 1869 and of 1870. He also stated that in his recording spectroscope it is not essential that the registering point should be attached to the telescope, but to the part which is moved for pointing on the lines of the spectrum. In Professor Young's spectroscope, in which the prisms move, the registering apparatus is attached to them.

Professor F. H. Storer presented the following paper on the amount of carbonic acid in the air, by Mr. A. H. Pearson.

The following paper contains an account of a large number of examinations of the air of various places for carbonic acid, made in the chemical laboratory of the Massachusetts Institute of Technology, during the spring of 1870, for the State Board of Health of Massachusetts.

They were made chiefly for the purpose of obtaining a general idea of the amounts of carbonic acid in the air of school-houses and other public buildings; but there are also among them quite a number of estimations of carbonic acid in the open air which may be of interest when compared with similar examinations made in other places.*

In these experiments the carbonic acid was determined by Pettenkofer's method. This method consists in exposing a certain quantity of standard baryta water to the action of a known volume of air, and thus removing the carbonic acid as carbonate of barium.

When the baryta water has been exposed to the air for a sufficient length of time, the baryta remaining in solution is estimated with a standard solution of oxalic acid.

The difference between the amounts of oxalic acid required to neutralize a certain quantity of baryta water, before and after the action of the air, represents the carbonate of barium formed, and from this quantity the carbonic acid present in the air is estimated.

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* See Dr. R. Angus Smith, in the Scottish Meteorological Journal, January, 1870; also the Second Annual Report of the Massachusetts State Board of Health, January, 1871.

The baryta water used in this process was prepared by dissolving 7 grms. of hydrate of baryta in one litre of water. The precise strength of this solution, as determined in the manner described below, was such that 1 c. c. of the solution corresponded to 1,087 mgrm. of CO_2. This solution was kept in a glass bottle, to the rubber stopper of which was fitted a tube containing soda-lime, and another tube just large enough to allow the passage of a pipette for drawing the baryta water.

In order to guard against the action of carbonic acid on the baryta water contained in the pipette from the mouth of the person using it, a tube filled with caustic potash was attached to its larger end. The soda-lime apparatus, noticed above, acted in the same capacity as the potash tube toward the carbonic acid in the air of the room.

The solution of oxalic acid was prepared as follows: — A saturated solution of pure oxalic acid in water was made and allowed to crystallize. These crystals were dried between folds of blotting-paper, and for one half-hour over concentrated sulphuric acid. 2.8636 grms. were then weighed out, dissolved in water, and the solution diluted to one litre. 1 c. c. of this solution corresponds to 1 mgrm. of CO_2.

The strength of the baryta water was determined as follows: — 25 c. c. of the baryta solution were transferred to a small flask, and the oxalic-acid solution run in from a Mohr's burette, until a drop of the mixture failed to give the alkaline reaction (a brown ring on delicate turmeric paper).

Repeated trials showed that 23 c. c. of the oxalic-acid solution were required to exactly neutralize 25 c. c. of the baryta water.

Three large glass bottles, with tightly fitting glass stoppers, were used for holding the air, in which the carbonic acid was to be determined. The capacity of each was obtained by filling with water and then measuring the same, by means of a flask holding 1,000 c. c. and a cylinder, graduated to single c. c. In this manner the capacity of bottle No. 1. reduced to 0° C., and 760 m. m. bar. press. was found to be 5824.10 c. c., that of No. 2, 6166,11 c. c., and of No. 3, 6240.57 c. c., an allowance of 50 c. c. being made in the calculation for the baryta water used in the process. Previous to each experiment the bottles were thoroughly cleansed and then dried by passing a current of heated air through them.

II. A saturated solution of oxalic acid in water was made as above; the crystals obtained were dried between sheets of paper, and a portion of them allowed to remain for one half an hour over sulphuric acid, and another portion for one hour. Solutions were made of these crystals of the same strength as above, and 25 c. c. of baryta water tested with the same results as before.

III. A saturated solution of oxalic acid in hot water was allowed to stand until nearly cold. The crystals thus obtained were rejected and the mother-liquor allowed to stand until another crop of crystals had deposited. These crystals were dried between sheets of paper and for one half an hour over sulphuric acid, a solution made of them, and the baryta water tested in the usual manner with a like result.

IV. A saturated solution of oxalic acid in cold water was allowed to remain over sulphuric acid, under a bell-glass, until a quantity of crystals was deposited. These were rejected and the mother-liquor returned to the bell-glass, and a second crop of crystals obtained, which were dried, pulverized, and a solution made of them. The baryta water was tested with this solution, the result obtained being the same as above.

The conclusion drawn from the above experiments was, that the oxalic acid employed in the regular analyses did not differ from that used in these experiments, where the conditions under which the solutions were obtained would not admit the presence of impurities in the oxalic acid.

The results of these examinations of the air for carbonic acid are as follows: —

I. — *Outer air in Boston.*

Locality.	Per cent. of Carbonic Acid by Volume.	Date. 1870.	Time.	Temperature. Centigrade. Deg.	Barometer. Inches.	Remarks.
Newbury Street, near Institute of Technology,	.04560	Mar. 17	11.00 A. M.	— 3.5	29.330	Cloudy, wind N. W.
	.03194	Apr. 1	8.45 “	9	30.372	Clear, wind N. E.
	.03894	“ 1	8.45 “	9	30.372	“ “
	.03988	“ 8	9.40 “	13	30.134	“ “
	.04449	“ 8	9.40 “	13	30.134	“ “
	.04218	“ 8	9.40 “	13	30.134	“ “
	.03798	“ 13	11.00 “	14	30.000	Clear, wind N.
	.04435	“ 13	11.00 “	14	30.000	“ “
	.04230	“ 14	2.35 P. M.	25	30.016	Clear, wind S W.
	.04292	“ 14	2.35 “	25	30.016	“ “
	.04999	“ 28	2.20 “	28	29.872	Cloudy, wind S. W.
	.04903	“ 28	2.20 “	28	29.872	“ “
Park St. near Tremont,	.04493	May 3	8.30 “	14	29.936	Clear, wind N.
Newbury Street,	.03394	“ 12	2.45 “	22	29.852	After storm; light clouds, wind S. W.
	.03561	“ 12	2.45 “	22	29.852	
Public Garden,	.02905	“ 17	10.45 A. M.	14	30.170	Cloudy, wind N. E.
	.03563	“ 18	4.05 P. M.	22	30.336	Clear, wind S. W.
	.02969	“ 19	10.50 A. M.	25	30.244	“ “
	.02586	“ 30	3.40 P. M.	20	30.264	Clear, wind S. E.
Cupola of State House,	.03139	“ 18	3.15 “	20.5	30.336	Clear, wind S. W.
Clarendon Place, near Berkeley Street,	.03371	“ 19	1.30 “	28	30.212	“ “

The details of a complete analysis are as follows: — Having filled the perfectly dry bottle, by means of a pair of bellows, with the air to be analyzed, 50 c. c. of the baryta water are added, and the interior surface of the bottle kept moistened by turning the same for about half an hour.

At the end of this time the baryta water is poured into a cylinder, the latter tightly corked, and the carbonate of barium allowed to deposit, requiring about fifteen minutes. 25 c. c. of the nearly clear liquid are now transferred to a small flask, and the oxalic acid solution run in from a burette, until a single drop of the mixture fails to give the alkaline reaction on turmeric paper. Taking, for example, the first experiment made on the outer air, it was found that 20.4 c. c. of the oxalic acid solution were required to neutralize 25 c. c. of the baryta water after the action of the air.

The difference between 20.4 c. c. and 23 c. c., the amount required to neutralize 25 c. c. of baryta water before the action of the air, being multiplied by 2, — *for 50 c. c. of baryta water were used in the experiment,* — we obtain 5.2 c. c., each c. c. of which is equivalent to nearly one mgrm. of carbonic acid, in accordance with the proportion:

$$\begin{array}{ccccc} \text{at.wt.} & \text{at.wt.} & & \text{wt. of } \bar{O} \text{ in} & \\ \bar{O} & CO_2 & & 1 \text{ c. c. of sol.} & \text{wt. of } CO_2. \\ 63 & : 22 & = & .0028636 & : .0009998 \end{array}$$

Multiplying this weight of carbonic acid by 5.2 c. c. and reducing the product to volumes in terms of c. c. at the normal temperature and pressure, we obtain 2.637 c. c. of carbonic acid in the volume of air analyzed. Bottle No. 1 having been used, after reducing its volume to the normal temp. and press., we obtain the percentage of carbonic acid by a simple proportion, thus: —

$$5783.26 : 2.637 = 100 : .04560\%.$$

In order to ascertain if the oxalic acid used in these experiments could be depended on for purity, the strength of the baryta water was tested with different solutions of the acid, prepared from crystals which were obtained under various conditions.

I. A solution of oxalic acid in hot water was made and allowed to crystallize. These crystals were dried between sheets of blotting-paper, 2.8636 grms. weighed out, dissolved in water, and the solution made up to a litre. 25 c. c. of the baryta water required 23 c. c. of this solution.

II. — *Rooms at the Massachusetts Institute of Technology.*

Locality.	Percent. of Carbonic Acid by Volume.	Date. 1870.	Time.	Temperature. Centigrade.	Barometer. Inches.	Remarks.
				Deg.		
Small “ weighing room,”	.13205	Mar. 15	3.00 P. M.	22	30.190	
Laboratory Inst. Tech.,	.13041	“ 15	3.00 “	22	30.190	
Drawing-room of	.08836	“ 16	9.40 A. M.	14	29.760	Wind N. E.
second year's class,	.08416	“ 16	9.40 “	14	29.760	“ “
Institute Technology,	.05693	“ 16	5.00 P. M.	15	29.760	“ “
	.05551	“ 16	5.00 “	15	29.760	“ “
Room 11 after recitation,	.09762	“ 17	1.15 “	21	29.330	
Institute Technology,	.08929	“ 17	1.15 “	21	29.330	

III. — *Air of School-Rooms in Boston.*

Locality.	Percent. of Carbonic Acid by Volume.	Date. 1870.	Time.	Temperature. Centigrade.	Barometer. Inches.	Remarks.
GRAMMAR SCHOOLS.				Deg.		
Myrtle Street,	.13431	Mar. 24	10.25 A. M.	23	30.200	
	.13659	“ 24	10.30 “	23	30.200	
Dartmouth “	.12912	“ 25	10.30 “	18	30.430	
Hawkins “	.09748	“ 29	10.20 “	21	29.906	
Tremont “	.14335	“ 29	3.00 P. M.	23	29.950	
Waltham “	.12111	“ 29	3.30 “	18	29.950	
Common “	.17686	“ 30	10.05 A. M.	18	30.260	
West Springfield “	.10164	“ 31	10.25 “	21	30.396	
Blossom “	.19037	April 5	10.30 “	22	29.900	
North Bennet “	.17887	“ 6	10.15 “	18	29.920	
Richmond “	.17781	“ 11	10.10 “	20	30.196	
Anderson “	.08570	“ 12	10.10 “	23	29.648	
Northampton “	.18622	“ 18	10.10 “	22	29.982	
Tyler “	.12586	“ 18	3.35 P. M.	20	29.850	
South “	.17598	May 10	10.15 A. M.	23	30.114	
PRIMARY SCHOOLS.						
Appleton Street,	.11092	Mar. 25	3.15 P. M.	20	30.460	
Hanover (Station House),	.14296	“ 28	10.30 A. M.	20	29.556	
110 Merrimack Street,	.18187	“ 28	11.15 “	20	29.556	
Poplar “	.11173	April 5	11.15 “	20	29.900	
North Bennet “	.16824	“ 6	10.25 “	20	29.920	
Richmond “	.08101	“ 11	10.20 “	22	30.196	
Phillips “	.08971	“ 12	10.20 “	22	29.648	
West Concord “	.13999	“ 18	10.25 “	21.5	29.982	
Tyler “	.11015	“ 18	3.50 P. M.	19	29.850	
Newbern Place,	.15541	“ 19	11.35 A. M.	23	29.796	
Warrenton Street,	.14575	“ 19	11.50 “	22	29.796	
Suffolk “	.10618	“ 19	3.35 P. M.	22.5	29.750	
Cooper “	.19927	“ 21	9.55 A. M.	22	29.888	
Thacher “	.17292	“ 21	10.10 “	23	29.888	
Sheafe “	.18692	“ 21	3.40 P. M.	22.5	29.856	
Snelling Place,	.16056	“ 21	3.55 “	19	29 856	
Genesee Street,	.16082	“ 22	9.50 A. M.	23	30.050	
Way “	.12284	“ 22	10.15 “	23	30.050	
Groton “	.14507	“ 25	11.20 “	20	30.092	
Rutland “	.11663	“ 25	11.45 “	22	30.092	
Hudson “	.13024	May 9	3.40 P. M.	18	29.856	
Common “	.07732	“ 9	3.55 “	18	29.856	
East “	.16988	“ 10	10.05 A. M.	22.5	30.114	
Chardon “	.09934	“ 11	10.15 “	22.5	30.034	
Blossom “	.12708	“ 11	10.50 “	21	30.034	

IV. — *Air of Halls, etc., in Boston.*

Locality.	Percent. of Carbonic Acid by Volume.	Date. 1870.	Time.	Temperature. Centigrade.	Barometer. Inches.	Remarks.
				Deg.		
Music Hall, Tremont St.,	.14045	May 4	4.05 P. M.	25	29.576	
Low tenement house, known as the "Crystal Palace," Lincoln St.,	.09530	" 17	2.30 "	23	30.242	
Open air in rear of above,	.03976	" 17	2.50 "	15	30.242	
Hall of Y. M. C. U., 300 Washington Street,	.15239	Apr. 27	9.05 "	26	30.060	
Municipal Court Room, Court Street,	.12047	" 20	1.30 "	23	29.784	
Office of Secretary of State, State House,	.08914	Mar. 22	2.45 "	24	29.892	
Printing office, 79 Milk St.,	.16183	Apr. 4	3.30 "	20	29.724	
Globe Theatre,	.14438	" 11	9.00 "	23	29.952	
St. Paul's Church,	.05929	" 15	11.00 A. M.	21	30.292	
Public Library, waiting-room,	.13666	Mar. 19	2.30 P. M.	20	30.150	
	.13747	" 19	3.45 "	21.5	30.150	
	.19352	Apr. 20	7.50 "	23	29.784	

Six hundred and thirty-second Meeting.

May 9, 1871. — MONTHLY MEETING.

The PRESIDENT in the chair.

The following Annual Report of the Council was read by the Corresponding Secretary.

Since the last report of the Council the following gentlemen have been elected members of the Academy: —

Charles C. Perkins, of Boston, to be a Resident Fellow in Class III., Section 4.

Nathaniel Holmes, of Cambridge, to be a Resident Fellow in Class III., Section 1.

Raphael Pumpelly, of Cambridge, to be a Resident Fellow in Class II., Section 1.

George Derby, of Boston, to be a Resident Fellow in Class II., Section 3.

E. J. Cutler, of Cambridge, to be a Resident Fellow in Class III., Section 2.

E. J. Young, of Cambridge, to be a Resident Fellow in Class III., Section 2.

C. C. Langdell, of Cambridge, to be a Resident Fellow in Class III., Section 1.

William Everett, of Cambridge, to be a Resident Fellow in Class III., Section 2.

Henry W. Paine, of Cambridge, to be a Resident Fellow in Class III., Section 1.

Charles Francis Adams, Jr., of Cambridge, to be a Resident Fellow in Class III., Section 3.

Ferdinand Bôcher, of Cambridge, to be a Resident Fellow in Class III., Section 4.

J. G. Whittier, of Amesbury, to be a Resident Fellow in Class III., Section 4.

C. C. Everett, of Cambridge, to be a Resident Fellow in Class III., Section 1.

Simon Newcomb, of Washington, to be an Associate Fellow in Class I., Section 1.

Truman H. Safford, of Chicago, to be an Associate Fellow in Class I., Section 1.

Henry J. Clark, of Lexington, Ky., to be an Associate Fellow in Class II., Section 3.

Henry Carey Lea, of Philadelphia, to be an Associate Fellow in Class III., Section 3.

George J. Brush, of New Haven, to be an Associate Fellow in Class II., Section 1.

Stephen T. Olney, of Providence, to be an Associate Fellow in Class II., Section 2.

Jeremiah Smith, of Dover, N. H., to be an Associate Fellow in Class III., Section 1.

Alexander Braum, of Berlin, to be a Foreign Honorary Member in Class II., Section 2.

Charles Merivale, of Oxford, to be a Foreign Honorary Member in Class III., Section 3.

G. Kirchhoff, of Berlin, to be a Foreign Honorary Member in Class I., Section 3.

Kaulbach, of Munich, to be a Foreign Honorary Member in Class III., Section 4.

Since the last Annual Meeting the Academy have lost, by death, two Resident Fellows and two Associate Fellows.

ELBRIDGE JEFFERSON CUTLER, the son of Elihu and Rebecca T. Cutler, was born at Holliston, Massachusetts, December 28, 1831. He was prepared for college at Westborough, under the tuition of Rev.

T. D. P. Stone, and entered Harvard College in 1849. In college he maintained a high standing, and at the close of his senior year was the class-poet. After graduating, he was engaged as a teacher in various places for about five years, for two of which he taught a private school in his native town. In 1858 and 1859, he was one of the editors of "The Century," a weekly literary journal published in New York. On quitting this employment he sailed for Europe, and spent a year in foreign travel and the study of the continental languages and literature. In 1861, he aided in the enlistment of a company for the national service in the great rebellion, engaging in the work with intense zeal, and expending in it almost all that he possessed; but was prevented from active duty by an injury occasioned by lifting a heavy weight in aid of a passing traveller, whose wagon was overturned near his mother's house. The spinal lesion from which he then suffered acutely made him an invalid for the rest of his life. At the Commencement of 1861, he read before the Phi Beta Kappa Society of Harvard College a patriotic poem, which won for him a very high reputation. From 1862 to 1864 he was a teacher in Worcester. He then spent another year in Europe. On his return, in 1865, he was chosen Assistant Professor of Modern Languages at Harvard College, and was appointed to a full and permanent professorship in 1870. Shortly before this last appointment he was prostrated by a new attack of spinal disease, in which he lingered for many weeks, not without hopeful symptoms of convalescence, till his life was closed by a sudden illness of an erysipelatous type, on the 27th of December, 1870, only a few weeks after his election as Fellow of the Academy.

Professor Cutler was endowed with native ability of a high order, and at the same time was, through life, a systematically industrious student and worker. While a good classical scholar, he was especially versed in the French and German languages and literature, and was, at the same time, familiar with the best writers in his own tongue. Indeed, few men of his years have united to a greater degree than he did special and general scholarship; so that, while a master in his own department, he was no sciolist in any branch of liberal culture.

As a writer, he was characterized by clear thought, pure, chaste, and transparent diction, and singleness and earnestness of purpose. The little that he wrote leaves only room for regret that it should have been so little. His poetry manifested a fertile fancy and no mean creative power, joined with great rhythmical euphony; and when he recited his own verse, he gave it an intense charm by the sweetness of his tones and the unaffected fervor of his utterance.

His preferred work, and that for which he was best adapted by nature and education, was that of a teacher. He made learning attractive both by his own example of the amenities and graces that belong to liberal culture, and by that keen appreciation of truth and beauty in thought, style, and expression, which won from his pupils their admiration of the literature which he opened to their knowledge. He understood, too, the modes of access to minds of various complexions, and was often successful in awakening capacities, tastes, and receptivities, which would have responded to no less skilful touch. He was at the same time the watchful and judicious friend, counsellor, and helper of his pupils, seeking their highest moral well-being, in rebuke faithful, but always kind, persevering and often eminently successful in his labors for the wayward and unpromising. For not a few students of the University, his interposition at a time of temptation or discouragement marked the turning-point of their career, and many will have life-long reason to thank him for their established virtue, industry, and well-being. His services as a College teacher were invaluable, and of his associates there probably is not one who did not regard him as occupying a place which may not easily be filled again.

His character in all its aspects commanded equal respect and affection. No man has had or deserved warmer friends. His purity, simplicity, integrity, and kindness made him the object of implicit confidence to all with whom he was associated, and in the nearer circle of home and social intimacy leave the most precious and hallowed memories.

The time has come when there must be stricken from the list of our living members a name which has stood there for more than fifty years.*

Of those members of the Academy who have taken small part in its discussions, and whose names do not appear in its memoirs, no one has done more to advance the objects for which the Academy was instituted than GEORGE TICKNOR. It is fitting, therefore, that we should pause a moment to take notice of his life, and of the great loss which Science, as well as Letters, has suffered by his death.

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* Mr. Ticknor was chosen into the Academy on November 8, 1820.

Mr. Ticknor, son of Elisha Ticknor, an intelligent and public-spirited man, one of those who first opened the doors of the public schools to all the children of Boston under the age of seven, was born in Boston, August 1, 1791. His father, a classical scholar, had been a teacher, and knew how safely to indulge the extraordinary power of application and attainment of his son, and to kindle within him the fire which always continued to burn, without checking his uncommon vivacity and playfulness, so that he was graduated at Dartmouth College, after a full and successful course, in 1807, at the age at which most boys in those days entered college.

Returning to Boston, he pursued his studies for three years under the care of the Rev. Dr. Gardiner, a worthy pupil of Dr. Parr, and was filled with that enthusiastic love of the Greek and Latin classics which he always retained. "His brightness, industry, ardor, and perseverance," says a friend who knew, "combined with agreeable, respectful, and gentlemanly manners," made him a favorite with Dr. Gardiner, who procured for his young friend admission to the Anthology Club, of which he was president, thus placing him amongst much older persons, the best scholars and most distinguished men of letters of their day.

He then devoted three years to the study of the law, in the office of William Sullivan, a good lawyer and a true gentleman, and was admitted to the bar in 1813. As it was impossible for him to do anything superficially, he gave promise of distinction in that profession. But, while he could not but retain the fruits of the severe mental discipline which faithful study gives, and gained from it, doubtless, something of the skill and wisdom with which he always managed his own affairs, as well as a safe guide in all his investigations, he preferred literature.

He went abroad in April, 1815, with his friend Edward Everett, and, after a few weeks in London, just at the time of the battle of Waterloo, hastened through Holland, stopping chiefly to buy books, to Göttingen, where they lived in contiguous rooms in the house of his favorite teacher, Bouterwek, whose highest work he was destined to surpass. At Göttingen he labored faithfully in his philological studies, from August in that year to March, 1817, during which time he became perfectly familiar with the German language.

In Paris, in the summer of 1817, in Rome through the following winter, and in Madrid from May to September, 1818, he studied with equal energy. During his residence on the continent, and in Edinburgh and London, he won the respect of such congenial spirits as Goethe and Humboldt, Sir Walter Scott, Francis Jeffrey, Wordsworth, Lord Byron, Southey, Lord Holland, and Sir James Mackintosh.

In Paris, he was intimate with Madame de Staël and her family and the Lafayettes, and in Madrid with the foreign diplomatists and some of the best Spanish scholars.

In 1820, he returned home and entered upon the duties of the professorship of French and Spanish Literature, to which he had been appointed in 1817.

Mr. Ticknor's lectures, and those of Edward Everett, formed an era in the history of the college; and from his intimate acquaintance with many of the ripest scholars, and with the highest scientific and literary institutions in the most advanced of the nations of Europe, he was able to present views which now prevail, and arouse a spirit which is now everywhere felt among us.

In 1821, he married Anne, daughter of Samuel Eliot, an eminent merchant of Boston.

In 1823, Mr. Ticknor published a syllabus of his course of thirty four lectures upon Spanish literature, in the introduction to which he expresses the hope so satisfactorily fulfilled, that he should, "by the labors of future years, supply the deficiencies on a subject so new, so important, and so interesting."

In 1825, Mr. Ticknor published "Remarks on the changes lately proposed or adopted in Harvard University," which, if they could all have been speedily adopted, would probably have rendered unnecessary several of the institutions which have since gone into operation in Boston and its neighborhood. In the same year Mr. Ticknor, to gratify a friend, caused to be reprinted in a little volume, with additions, from the pages of the North American Review, "Outlines of the Principal Events in the Life of General Lafayette," which Edward Everett calls "Mr. Ticknor's beautiful sketch of the life of Lafayette." A French translation of this, was, in the same year, printed in Paris.

In 1827, he wrote a memoir to accompany the remains of R. A. Haven, of which an excellent judge says, "It is such a portrait as his friends delight to recognize, such as all wish to resemble, and yet such as his worst enemy could not help allowing to be just."

In 1832 he delivered, before the American Institute of Instruction, a lecture on the "Best Methods of Teaching the Living Languages," which he draws from his own observation and experience in the best schools in Europe. This is most valuable, as it offers guidance in teaching ancient as well as modern languages from one thoroughly acquainted with all the best methods.

Mr. Ticknor resigned his professorship in 1835, after fifteen years of uninterrupted service, during which time and for the remainder of his life he exercised a generous but modest hospitality. Fortunate and happy in his domestic relations, he gave a cordial welcome not only to his old friends, whom he never forgot, such as Dr. Bigelow, James Savage, William H. Prescott, not only to distinguished men of letters, like Professor Felton and Mr. Hillard, and the Danas, but to men of science, like Bowditch, Lyell, Agassiz, and the brothers Rogers, and to worthy citizens and men of distinction in other walks of life, such as Judge Story and Daniel Webster, thus doing what can best be done to awaken sympathy and mutual respect between those engaged in sciences, letters, business, and the affairs of state.

After a residence in Europe of three years, understood to have been principally occupied in collecting materials of every kind for his "History of Spanish Literature," he returned home, and, in 1849, that work appeared, which Humboldt calls "a masterly work," and of which H. T. Buckle says, "In it there is more real information than can be found in any of the many Spanish histories I have had occasion to read." This noble work stands alone; most agreeable, instructive, and entertaining, though upon a subject which, treated with less knowledge, taste, and discrimination, has usually been found heavy and tedious.

In 1863, Mr. Ticknor gave us the life of his dearest, life-long friend, William Hickling Prescott, — who, younger than himself, had once expressed the hope that it "might be long before he should do the good turn for his friend Ticknor of writing his obituary." There is not, perhaps, in any language, a biography more delightful, or containing more precious, suggestive instruction for a young student, than Ticknor's "Life of Prescott."

If untoward circumstances had not prevented the execution of his own cherished purpose, we should now have, as a pendant to the Life of Prescott, a life, by the same hand, of Daniel Webster. Of his ability to do it in an incomparably perfect manner, we have not only the evidence of the Life of Prescott, but we have his "Remarks on the Life and Writings of Daniel Webster," which came out in a pamphlet in 1831, taken, with additions, from the American Quarterly Review. This is a rapid but beautiful sketch of the life of the great statesman by a kindred spirit who justly and feelingly appreciates all that is great and admirable in his character.

Besides these larger works, Mr. Ticknor furnished valuable communications in every part of his life to the Anthology, the North American Review, the Christian Examiner, and other Reviews, upon subjects of interest to scholars and men of science.

He could never be idle; and very much of his time, in the last years of his life, was given to the Boston City Library. No one could be better qualified for this labor than Mr. Ticknor was, by acquaintance with the best books on all subjects, and by the experience he had had in forming his own unsurpassed library, of which the portion relating to Spanish literature was the most complete collection known. This, with thousands of other volumes, he gave or he bequeathed to the City Library.

These precious gifts will be gratefully enjoyed by many generations of American scholars, who can only know Mr. Ticknor by his writings, and can look upon him only in the exquisite bust by Milmore, which adorns the Upper Hall of the Library.

Mr. Ticknor died, in the eightieth year of his age, on the morning of the 26th of January, 1871. The one best fitted to know and to judge of his virtues as well as his accomplishments has given him the simple but all-sufficient title of the Christian Scholar.

The Hon. John Pendleton Kennedy was born in Baltimore on the 25th of October, 1795, and was graduated at Baltimore College in the seventeenth year of his age. After a brief service in the field, as a volunteer, during our last war with England, he entered on the practice of the Law, and gave the best promise of becoming a conspicuous member of the Maryland bar. But literature and politics soon diverted him from professional pursuits, and he will be remembered mainly as an author and a statesman. His principal productions in literature were "Swallow Barn, or a Sojourn in the Old Dominion," published in 1832; "Horse Shoe Robinson, a Tale of the Tory Ascendancy," published in 1835; and "The Life of William Wirt," in two volumes, published in 1849. In political life, he served successively as a member for many years of the House of Delegates of Maryland, of which he was more than once the Speaker; as a

Representative in Congress; and, finally, as Secretary of the Navy of the United States, in the Cabinet of President Fillmore. In the later years of his life he was Provost of the University of Maryland, and President of the Peabody Institute, founded by his friend, the late illustrious George Peabody, in the city of Baltimore. To every station which he occupied Mr. Kennedy brought brilliant accomplishments, an active and earnest mind, a quick wit, a ready pen, an eloquent voice, and great devotedness of purpose. No man of our day has left a more enviable memory for the fidelity of his public labors, or the purity of his private life. He died at Newport, Rhode Island, on the 18th of August, 1870, universally respected and lamented.

William Chauvenet was born in 1820, at Milford, Pennsylvania; but his early life was chiefly passed in Philadelphia, whither his parents removed while he was still very young. His father was a grocer, and wished his son to succeed him in his business; but he gave so decided evidence of mathematical talent, while at school, that he was sent to Yale College, where he was graduated with distinction in 1840. After a short service under Professor Bache, in meteorological observations at Girard College Observatory, he became, in 1841, instructor in Mathematics at the United States Naval Asylum in Philadelphia; and, on the foundation of the United States Naval Academy at Annapolis in 1845, he was appointed one of its Directors, and was also made Professor of Astronomy and Mathematics, and Director of the Observatory. His connection with this Academy continued fourteen years, during which his growing eminence as a mathematician, and his ability and zeal as a teacher, contributed very strongly to give a high character to the institution. In 1859, he was offered the professorship of Astronomy and Mathematics at Washington University, St. Louis, and also that of Natural Philosophy and Astronomy at Yale College, which had previously sought him for her chair of Mathematics. Though strongly attached to his *alma mater*, he chose St. Louis, in the belief that it presented a wider opportunity of usefulness, and entered on his new duties in the autumn of the same year. In 1862, he was appointed Chancellor of the University, — an indication of the commanding impression he had already made there in other ways than in the line of his special studies. But, unfortunately for the University, and deeply to the disappointment of all friends of higher education and students of mathematical science in America, Dr. Chauvenet's health became seriously impaired shortly after his appointment to his new office, and it was never afterward re-established. After several periods of partial recovery, he resigned the chancellorship in 1869, and he died on the 13th December, 1870.

Dr. Chauvenet was the author of "Binomial Theorem and Logarithms" (1843, 92 pp. 8vo), of "A Treatise on Plane and Spherical Trigonometry" (1850, 256 pp. 8vo), "A Manual of Spherical and Practical Astronomy" (1863, 2 vols., 708 and 632 pp. 8vo), and "A Treatise on Elementary Geometry" (1870, 368 pp. 8vo). His special investigations, published in various journals and volumes of proceedings, are mostly embodied in the treatises above named.

Dr. Chauvenet is most widely known through his Trigonometry, a truly admirable text-book of the first class in respect of method and of arrangement, and so full that while it is entirely adapted to the instruction of beginners, it is invaluable as a book of reference to the professed mathematician. It is constructed on the excellent plan of embracing in one volume the whole general theory of the trigonometric functions in its higher developments, as well as in its elementary principles; and this plan is carried out with so much learning and industry, that, in spite of some deficiencies with respect to topics which have recently acquired importance, the book is still, after the twenty-one years that have elapsed since its publication, the most complete existing work on the subject of which it treats. It must long remain a classical treatise. The Astronomy exhibits the same qualities of full and exact learning and of elegance in form. It embraces the thorough discussion, according to the best methods, and well illustrated by actual examples, of all the problems which arise in the ordinary work of a practical observatory; and it is in use among working astronomers all over the world. The Geometry is an essay in a field of mathematical science to which Dr. Chauvenet's genius was less strikingly adapted than to that of analysis. It is, however, an important contribution to the discussion concerning the treatment of pure geometry, which is just now exciting a renewed interest among mathematicians. But whereas the Trigonometry and Astronomy may be said to have left nothing to be desired in their respective subjects, this, from the nature of the case, could not be true of any treatise on so many-sided and profound a subject as that of geometry. The introduction of some of the modern ideas (while others are, perhaps arbitrarily, excluded), and the appendixes, containing a large and excellent series of examples and a good introduction to the Chaslesian Superior Geometry, give a special character and a high value to the book, which is marked throughout by those excellences which belong to all the works of its author.

As a mathematician, Dr. Chauvenet is distinguished by extensive learning, inexhaustible patience and thoroughness of research, exactness of method, good choice of points of view, and a very high degree of elegance and skill as an analyst. His works, judged as books of elementary instruction, are direct and clear in mathematical style, and quite free from that painful amplification of first principles which too often characterizes text-books pretending to scientific accuracy; while, considered as embodying the complete development of their respective subjects, according to the best and latest researches, in a highly practical and well-digested form for working mathematicians, they are books of the first order. The labors of few American mathematicians have reflected so much credit on science in this country; and it is to be lamented that the early decline of his health cut short a career which had already been so honorable, and which, it was hoped, would yet present an exemplification of still higher forms of mathematical power. His private character was most estimable, attractive, and delightful. His whole course in life was governed by the highest principles, both in the purity and devotion with which he fulfilled his active relations, and in the thoroughness of his scientific work. His disposition was entirely amiable, and his companionship was full of the charm which proceeds from a sprightly, cultivated, and high-minded intelligence.

Dr. Jarvis presented a paper on the longevity of the European races in the United States.

Remarks on this communication were made by Messrs. E. H. Clark, N. G. Shaler, Nathaniel Holmes, and Edmund Quincy.

Six hundred and thirty-third Meeting.

May 30, 1871. — ANNUAL MEETING.

The PRESIDENT in the chair.

The President read the following letter from Professor Daniel Treadwell: —

DEAR SIR, — I inclose herein a check for two hundred dollars, which I request you to present to the American Academy of Arts and Sciences, to be expended in procuring an accurate and copious index to the works of Count Rumford, which the Academy is now collecting and publishing.

I am very sincerely,
Your friend and servant,
DANIEL TREADWELL.

Voted, That the thanks of the Academy be presented to Mr. Treadwell for his generous and thoughtful gift.

The following gentlemen were elected Members of the Academy: —

Francis L. Pourtales, of Cambridge, to be a Resident Fellow in Class II., Section 3.

Robert Amory, of Brookline, to be a Resident Fellow in Class II., Section 3.

Samuel W. Johnson, of New Haven, to be an Associate Fellow in Class I., Section 3.

Charles A. Young, of Hanover, N. H., to be an Associate Fellow in Class I., Section 2.

Leo Lesquereux, of Columbus, Ohio, to be an Associate Fellow in Class II., Section 2.

The Corresponding Secretary read the report of the Committee of Publication, which was accepted and ordered to be placed on record.

The President read a Report of the Librarian; also a note from him declining re-election as Librarian or Member of the Rumford Committee.

The President read a Report of the Treasurer, and stated that the latter also declined re-election.

The Report was accepted and ordered to be placed on record.

It was voted that this meeting adjourn, at its close, to the evening of Tuesday, June 6, when the subject of the funds of the Academy would be discussed.

It was voted that the cordial thanks of the Academy be presented to Professor F. H. Storer, Mr. C. J. Sprague, and Professor Joseph Winlock, for their valuable services as officers of the Academy.

The annual election resulted in the choice of the following officers: —

Asa Gray, *President.*
George T. Bigelow, *Vice-President.*
Joseph Lovering, *Corresponding Secretary.*
Edward C. Pickering, *Recording Secretary.*
Edmund Quincy, *Treasurer.*
Edmund Quincy, *Librarian.*

Council.

Thomas Hill,
Josiah P. Cooke, Jr.,
John B. Henck,
} of Class I.

Alex. E. R. Agassiz,
Jeffries Wyman,
Charles Pickering,
} of Class II.

Robert C. Winthrop,
George E. Ellis,
Andrew P. Peabody,
} of Class III.

Rumford Committee.

Morrill Wyman,
Wolcott Gibbs,
Josiah P. Cooke, Jr.,
James B. Francis,
John M. Ordway,
Stephen P. Ruggles,
Edward C. Pickering.

Committee on Finance.

Asa Gray,
Edmund Quincy,
} *ex officio*, by statute.
Thomas T. Bouvé, by election at adj'd annual meeting.

The other Committees were appointed, on the nomination of the President, as follows: —

Committee of Publication.

JOSEPH LOVERING, JEFFRIES WYMAN,
WILLIAM W. GOODWIN.

Committee on the Library.

CHARLES DEANE, FRANK H. STORER,
EDWARD C. CABOT.

Auditing Committee.

CHARLES J. SPRAGUE, THEODORE LYMAN.

Six hundred and thirty-fourth Meeting.

June 6, 1871. — ADJOURNED ANNUAL MEETING.

The PRESIDENT in the chair.

In accordance with the Report of the Committee on Finance, it was voted to appropriate from the General Fund: —

For General Expenses	$2,100
For Publications	850
For Library	350

The Chairman of the Rumford Committee read anew the report presented at the Annual Meeting, and the one read April 11.

It was voted that the Rumford Premium be awarded to Mr. Joseph Harrison, Jr., of Philadelphia, for his method of constructing steam-boilers, by which great safety has been secured.

Dr. Ellis suggested that a new die should be procured before giving the Rumford Medal, as the present one does not agree with the other likenesses of the Count. Referred to the Rumford Committee.

It was voted that the Rumford Committee be empowered to make such arrangement or contract regarding the publication of a cheap edition of the Life of Count Rumford as may seem to them advisable.

It was voted that the Treasurer be authorized, with the advice of the Finance Committee, to borrow a sum not exceeding three thousand dollars, in anticipation of the income of the present year.

It was voted to proceed to the election of the third member of the Committee of Finance, who was not chosen at the last election.

The ballot resulted in the election of Mr. T. T. Bouvé.

It was voted to omit the Stated Meeting in August, and to hold it on the second Tuesday in September.

Professor Winlock made a communication on a method of viewing, with the spectroscope, the whole sun at once, with the protuberances. He used a telescope of six inches focal length, giving an image of the sun about $\frac{1}{20}$ of an inch in diameter. The centre of this image was eclipsed by a small brass pin in a plate of glass, which replaced the slit. A thin annulus was thus received into the collimator of the spectroscope. He next tried a simple spot of silver on the glass, also silvering the latter, and cutting a circle in it. The image thus formed should be magnified with a telescope of considerable power after dispersion by the prisms. By using silvered specula and a heliostat, it would be found practicable to employ a spectroscope of very high dispersive power.

Six hundred and thirty-fifth Meeting.

September 13, 1871. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

The President announced the death of Professor Immanuel Bœkker, Dean Mansel, Sir J. F. W. Herschel, and Mr. George Grote, of the Foreign Honorary Members; Dr. Holbrook, of the Associate Fellows; and Mr. Charles Jackson, of the Resident Fellows.

Professor Whitney made a communication on some experiments he has been conducting on the use of the barometer in the determination of elevations. He showed that, after applying all the known corrections, a residual error remained, owing to which observations made in winter sometimes gave results a hundred feet lower than those made in summer.

Remarks on this communication were made by the President, and Messrs. L. Agassiz, B. Peirce, and T. M. Brewer.

Professor E. C. Pickering showed a new application of Fresnel's formula of Reflection.

If i and r are the angles of incidence and refraction, and A and B the magnitudes of the two reflected beams polarized at right angles, we have $A = \frac{\sin^2 (i - r)}{\sin^2 (i + r)}$ and $B = \frac{\tan^2 (i - r)}{\tan^2 (i + r)}$. If in these we make the index of refraction $= 1 + dn$ or very nearly unity, we obtain by differentiating and reducing $A = \frac{dn^2}{4} (1 + \text{tang}^2 i)^2$ and $B = \frac{dn^2}{4} (1 + \text{tang}^2 i)^2$.

Substituting in these formulas different values of i we compute the accompanying table. The first column gives i, the second A or more strictly $(1 + \text{tang}^2 i)^2 = \frac{1}{\cos^4 i}$. The third column gives B or the amount of light polarized in the plane of incidence; the fourth $\frac{1}{2}$ (A + B) the total light reflected, and the fifth $\frac{A - B}{A + B} \cdot 100$, or the degree of polarization in percentages. It will be noticed that at 45° the polarization is complete. Now the light of the sky may be accounted for, if we suppose the sunlight specularly reflected by very minute surfaces of air or aqueous vapor, the index of refraction in this case being very near unity. Our table then shows that the light should increase from the antisolar point towards the sun, becoming very great near the latter. At a distance of 10° the angle of incidence would be $\frac{180 - 10°}{2} = 85°$, and the light over 17,000 times as great as opposite the sun. Again, the polarization would attain its maximum 90° from the sun. These phenomena are quite in accordance with the observed facts.

i	A	B	$\frac{1}{2}$ (A + B)	$\frac{A - B}{A + B}$
0	1.00	1.00	1.00	00.0
10	1.06	.94	1.00	6.2
20	1.28	.75	1.02	26.0
30	1.78	.44	1.11	60.0
40	2.90	.09	1.50	94.5
45	4.00	.00	2.00	100.0
50	5.86	.18	3.02	94.1
60	16.00	4.00	10.00	60 0
70	73.08	42.88	57.98	26.0
80	1099.85	971.21	1035.53	6.2
85	17330.64	16808.08	17069.36	1.2
90	∞	∞	∞	

Six hundred and thirty-sixth Meeting.

October 10, 1871. — Monthly Meeting.

The President in the chair.

The President announced the death of Professor Mahan, of West Point, one of the Associate Fellows. He also read a letter from Mr. Kenwood, announcing the donation to the Academy of two books written by him.

Mr. Chauncey Wright read a paper on *Phyllotaxis, or the arrangements of leaves in plants.* This paper will be published in the Memoirs of the Academy.

Six hundred and thirty-seventh Meeting.

November 8, 1871. — Stated Meeting.

The President in the chair.

The Corresponding Secretary read letters from Messrs. Johnson, Lesquereux, Pourtales, and Young, acknowledging their election into the Academy.

The President announced the decease of Sir Charles Babbage, Sir Roderick Murchison, and Fourneyron, all Foreign Honorary Members.

It was voted to grant the request of the American Society of Numismatics to borrow the steel plate of the Rumford Medal, in order to have three hundred copies struck off by Forbes & Co. for the use of that society.

It was voted to authorize the Rumford Committee to sell the remainder of the edition of the Life of Count Rumford, and to contract with an agent for the sale of the new edition of the Works of Rumford.

It was voted to authorize the completion of the second volume of the Works of Count Rumford, at an expense not exceeding $1000.

The following gentlemen were elected Fellows of the Academy: —

H. G. Denny, of Boston, to be a Resident Fellow in Class III., Section 2.

John Trowbridge, of Cambridge, to be a Resident Fellow in Class I., Section 3.

J. A. Allen, of Cambridge, to be a Resident Fellow in Class II., Section 3.

William H. Pettee, of Cambridge, to be a Resident Fellow in Class II., Section I.

John K. Paine, of Cambridge, to be a Resident Fellow in Class III., Section 4.

Edwin P. Seaver, of Cambridge, to be a Resident Fellow in Class I., Section I.

Professor Benjamin Peirce made a communication on the effect of the consistency of the interior of the earth on the Precession of the Equinoxes. Mr. Hopkins claimed that the effect of the fluidity of the interior would be to render the precession much greater. This view was controverted by Monsieur Delaunay, but sustained by Mr. Pratt. Professor Peirce maintained that, owing to friction, a certain velocity would be imparted to the interior, even if liquid, so that it would produce the same effect as if solid.

Dr. Charles Pickering stated that, having seen the earth's crust forming, he would make a few remarks on the subject:

At the time of his visit to Hawaii there were two lakes of liquid lava at the bottom of the Great Crater; the larger lake remained always liquid, but the smaller one, "two hundred feet" in diameter, occasionally congealed over. Here is one point gained: for it has been argued, that the material of the Earth, if once entirely fluid, in cooling would contract, become heavier, and sink; therefore forming a crust is impossible. It is forgotten that a perfectly dry cambric needle can be placed on water so as to float, and for the reason, that it displaces more of the water than its own bulk. So in the irregularities of the earth's surface commonly attributed to the cooling material contracting, we can distinguish a general tendency to concavity, proportionably diminishing and counterbalancing increase in weight.

To return to the smaller lava-lake, when the congealed crust broke up, there was a different state of things. In thickness, this crust seemed six or eight inches; and back from its edge, usually several feet, a crack would make its appearance, showing a red glow from beneath;

presently a little liquid lava would ooze forth, and the flow would detach itself, sinking at its outer margin, or seeming to be hurried obliquely downwards under the molten mass. In this manner floe after floe was hurried out of sight, until the molten portion had all around gained the bank.

Professor N. S. Shaler spoke of the effect of changes in the temperature of the moon's surface. Mr. Harrison has shown that this amounts to about 960° F., or from —100° to 840°, assuming the specific heat equal to that of quartz. The effect of such a change on a level plain like the Mare Humorum would be to alter its length half a mile. He proposed to detect such changes by accurate measurements of known points on the moon's surface. So great a variation in temperature would account for the observed alterations of color which have been ascribed to a rapid growth of vegetation.

Professor Benjamin Peirce suggested that these changes in position could be best measured on Mr. Rutherford's photographs of the moon, points near the centre of the disk being selected and measured during the first and last quarter.

Professor E. C. Pickering expressed a doubt whether this method would possess sufficient delicacy, as a variation of one mile would equal only about a second of arc, and the measurements would be complicated by libration, and all the considerations which render so uncertain the moon's diameter.

Professor Benjamin Peirce referred to the Coast Survey steamer now preparing to go to the Pacific for scientific purposes. With a capacity of 350 tons it can make 200 miles a day, while burning less than three tons of coal. Therefore, it can carry enough of the latter for a voyage of 8000 miles. The statement of Dr. Lardner, that no steamer under 500 tons could cross the Atlantic by steam alone, is thus completely disproved, as this vessel could easily make the trip and return without recoaling.

Six hundred and thirty-eighth Meeting.

December 12, 1871. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Messrs. Henry G. Denny, John Trowbridge, and John K. Paine, acknowledging their election into the Academy, and he announced that Part First, of Vol. X. of the Memoirs of the Academy, containing Professor Joseph Lovering's *Memoirs on the Periodicity of the Aurora*, was now ready for distribution.

The President called the attention of the Academy to the recent decease of Mr. J. G. Cogswell, the oldest Resident Fellow, with one exception, of the Academy.

The Chairman of the Rumford Committee announced that the medal awarded to Mr. Joseph Harrison, Jr., was ready for presentation, and it was voted, — That this medal be presented at the monthly meeting in January.

The following gentlemen were elected into the Academy: —

R. W. Hooper, of Boston, to be a Resident Fellow in Class II., Section 4.

J. B. Pettee, of Cambridge, to be a Resident Fellow in Class II., Section 1.

S. P. Sharples, of Cambridge, to be a Resident Fellow in Class I., Section 3.

G. R. Baldwin, of Quebec, to be a Resident Fellow in Class I., Section 4.

Professor A. P. Rockwell exhibited some fragments of the tusk of a mastodon, discovered by Captain Bethune about four miles from Golden City.

Professor N. S. Shaler made a communication supplementary to that presented by Mr. Wright, at a previous meeting, on Phyllotaxis. He showed that the parts of some of the highest polyps are arranged like the leaves of plants. Polyps may be divided into two groups: first, those which are nearly flat, forming a level sheet; and, secondly, those grouped along a stem. In the latter the different individuals are arranged often in spirals.

The fraction for the *Oculina* is about one fifth, for the *Madrepore* a higher ratio, while for the *Carnapsammia* it is less than one third.

Professor Benjamin Peirce made a communication on the mean motions of the four outer planets. After referring to the curious relation noticed by Laplace, that the mean motion of Jupiter is very nearly five times that of Saturn, and to his own observation, that the mean motion of Uranus is about twice that of Neptune, he proceeded to show the following new relation between these mean motions: — $3n_7 + 8n_8 - n_5 = o$. $4n_6 - 16n_7 + 9n_8 = o$, and $2n_5 - 12n_6 + 17n_8 + 6n_9 = o$. Laplace has shown that if such relations are approximately true they must, in time, become accurately so; and hence these equations afford an excellent means of computing the mean motions of Saturn, Uranus, and Neptune, assuming that of Jupiter. The results are for Saturn, 44.001.805 sec., for Uranus, 15.428.182 sec., and for Neptune, 7.871.511 sec., which agree very nearly with observation.

Mr. William Everett proposed —

A new reading in Virgil, Æneid, Book I. Line 445.

The reading of all the MSS. here is: — Egregiam, et facilem VICTU per saecula gentem. The interpretations of the word *Victu* here are various. Some commentators venturing to take it from *vincere*, and using it actively, so that *facilem victu* = *victoriâ pollentem*. Most, however, take it as a latter supine from *vivo*, or ablative singular from *victus*, and make *facilem victu* = *facilem victum habituram*. This view is best stated by Heyne, *Excursus ad locum*, who compares, but, in my opinion, inaptly, Georg. II. 460, Æn. VIII. 318. His statement has satisfied later commentators. Weidmann (Commentar zu Virgil's Æneis, B. I. und II. Leipzig, 1869) has summed up all the learning that can be advanced on it.

I confess that, after all possible parallels have been adduced, I cannot find either a symbol of fertility or wealth in a war-horse; nor can I think *facilem victu* a natural expression in the sense given it. I therefore propose to read Facilem VECTU — the *E* and *I* in the best uncial MSS. differing exceedingly little from each other.

Thus we shall have Virgil's very favorite word *vehor*, I *move*, or *am* *transported*, so appropriate to the Carthaginian navigators who monopolized the *carrying trade* of the ancient world. This quality is symbolized by the horse, the type of transportation all over the world, and chosen by all poets as the emblem of the sea, from Homer in the Fourteenth Book of the Iliad to Byron in the finale to Childe Harold.

This emendation was suggested to me many years ago by my late revered father.

Six hundred and thirty-ninth Meeting.

January 9, 1872. — MONTHLY MEETING.

The CORRESPONDING SECRETARY in the chair.

Professor J. P. Cooke read the following statement by the Rumford Committee of the grounds on which the Rumford Medal was awarded to Joseph Harrison, Jr., of Philadelphia, by vote of the Academy passed May 30, 1871. This statement was adopted by the Committee at a full meeting held December 23, 1871.

An award of the Rumford Medal was made at the annual meeting of the Academy, May 30, 1871, in the following terms: — "Voted, that the Rumford Medal be awarded to Joseph Harrison, Jr., of Philadelphia, for his mode of constructing steam-boilers, by which great safety has been secured."

The "Harrison Boiler" consists of a number of hollow cast-iron spheres, about eight inches in external diameter, and three eighths of an inch thick. These spheres are cast in groups of two or four, the spheres of each group being arranged in straight lines, and connected with each other by curved necks about three and one quarter inches in diameter. Moreover, each sphere has two half-necks, which make openings at right angles to the necks previously mentioned. The open necks are rabbeted, so that any number of the groups of spheres (units, as they are called) may be united to each other, and the system thus built up is held together by wrought-iron tie-bolts, which pass through each line of spheres in the direction of the half or jointed necks, connecting at each end with caps that close the external orifices of the end spheres on each line. The castings are made with such uniformity, and the necks turned so as to fit each other with such accuracy, that when the rabbeted edges are adjusted and drawn together by the screw and nut at the end of each bolt, a perfectly steam and water tight joint is secured, without the intervention of cement or packing. A system of spheres thus united, six wide and twelve or thirteen long, forms what is called a section; and a boiler consists of several of these sections, all discharging steam into the same pipe. In setting the boiler the sections are placed on edge, side by side, so that the lines of bolts make an angle of about forty degrees with the furnace grate.

The security of the Harrison boiler depends on the following features in its mode of construction. In the first place, the spherical form, adopted for the units of the boiler, greatly economizes the tensile strength of the iron, and it has been estimated that, with a metal having a tensile strength of three and one half tons to the square inch, the bursting strength of the units would be nearly three fourths of a ton per square inch. The strength of a boiler consisting of such units will, of course, be no greater than that of the weakest sphere of the structure; but as all the sections are tested at the manufactory by hydrostatic pressure, as high as three hundred pounds to the square inch, a defective unit is discovered before the boiler is delivered to purchasers.

It is not maintained, however, that the units of the Harrison boiler cannot be burst under excessive pressure; for, as experience has shown, it is impossible to make a vessel, at least one of any practical value as a steam-generator, which cannot be burst. It is merely a question how high a temperature it can stand before yielding. But the evidence before the Rumford Committee has sustained the opinion that, in case of such an accident to the Harrison boiler, a violent destructive explosion is almost impossible; and this brings us to the consideration of the second feature on which the security of this boiler depends.

In an ordinary plate-iron boiler the yielding at any point almost inevitably involves the rending and complete destruction of the whole structure. A tear started at a defective rivet, or on a line of corrosion, will instantly lay open the whole vessel, when the expanding steam scatters the contents in all directions, and hurls the fragments with a force which no ordinary constructions of buildings or ships can withstand. The recent experiments of Mr. Stevens, of Hoboken, as described in a report to the Secretary of the Navy by three of the chief engineers in the naval service, show very conclusively that this tearing apart of the boiler-plates under pressure is the simple cause of the destructive explosions of plate-iron boilers, and, to use the words of the report, "that in accounting for either the fact of an explosion, or for its destructive effects, there is no necessity for hypothesis of low water, enormous pressures, instantaneous generation of immense quantities of steam, superheated steam, the formation of hypothetical gases, the development of electricity, &c., &c. The most frightful catastrophe can be produced by simply gradually accumulating the pressure of the saturated steam to a strain, at which the strength of the boiler yields, nor need that pressure be much above what is ordinarily employed with boilers of this type." In one experiment the boiler exploded with most destructive violence in less than a quarter of an hour after the pressure had passed the inspector's limit.

Such a sudden tearing open of the whole vessel has never taken place, and does not seem to be possible, with the Harrison boiler. Under an excessive pressure the weakest units in the system may yield, and injury may be caused by the sudden discharge of water, or of steam; but the injury to the boiler must be, to a great extent, local, probably extending only to the breaking of a single unit, and involving, at the most, a rapid but still regulated emptying of its contents. The parts being wholly independent, there is no tendency in a rupture to extend from one unit to its neighbor's; and moreover, as a general rule, long before the bursting-point is reached, a third feature of the boiler comes into play, which, perhaps, more than either of the other two, protects it from destructive explosions. The units of the boiler not being cemented together, the least yielding of the tie-bolts opens every joint and makes each of them a safety-valve. That this is the normal action of the boiler under excessive pressure has been abundantly established, not only by the experiments made by Mr. Harrison before a committee of the Franklin Institute, but also by the experience of a member of our own committee.

The Rumford Committee were satisfied, by the evidence herein stated, that the Harrison boiler is not liable to those violent destructive explosions referred to above, and to which the ordinary plate-iron boilers, however carefully or strongly made, must be always more or less exposed. Considering further the economical advantages to be gained from high-pressure steam, and the paramount importance of such security as Mr. Harrison has attained in the use of this powerful agent, they felt themselves justified in making the recommendation, on which the Academy acted, in awarding to him the Rumford medal. It must be noticed, however, that the award has been made for a "mode of constructing steam-boilers, by which *great safety is secured*," and that the safety of the boiler is the only point on which the committee based their recommendation. They did not feel themselves called upon to weigh carefully the relative merits of the Harrison boiler when compared in other respects with the many forms of steam-boilers now in use. They considered that its already extended and rapidly increasing use was sufficient evidence that the Harrison boiler was an efficient and economical steam-generator. More than this they did not require to be proved; for whatever might be the defects of the boiler, — and some doubtless there are, — the committee considered that Mr. Harrison had made an important advance in the application of steam by demonstrating experimentally the principles on which a safe steam-boiler can be made, and working them out to a practical result. These principles being established, we may hope that any defects in the present construction may be hereafter remedied.

It remains only to consider how far the principles or features of construction to which we have referred are original with Mr. Harrison. At least twenty-five years ago Dr. Ernst Alban, a distinguished German engineer, clearly recognizing the impossibility of securing safety in a steam-boiler by strength of materials alone, advanced the important opinion that the only sure method of avoiding danger is "so to construct the boiler that its explosions may not be dangerous"; and in a valuable work originally published in Germany, but of which an English translation, published in 1843, was alone before the committee, a mode of constructing steam-boilers is described in which this principle is skilfully applied. Mr. Harrison has adopted the principle of Dr. Alban, and, in a pamphlet on the steam-boiler, published at Philadelphia in 1867, he prints the opinion of Alban, quoted above, at the head of his essay; but his method of embodying this principle is as dissimilar as possible. Moreover, he has carried out the principle more fully than Alban himself. The German boiler, like the American, is made in sections, so that the bursting of one would bring no destructive consequences from the general body of the boiler; but it is merely a modification of the well-known tubular boiler, and does not combine the advantages which Harrison obtains from the spherical form of his units, and the mode by which they are bolted together without rivets or cement.

But the merit of Mr. Harrison and his claim to the Rumford medal consists fully as much in the skill with which he has overcome the difficulties in the details of the construction of his boiler as in the ingenuity of the original design. The boiler is not an ideal conception, but an accomplished result, of which the industry of the country is enjoying the benefit. By Mr. Harrison's labors, high-pressure steam has been brought more under control, and human life has been rendered more secure. The Rumford Committee believe not only that in awarding the Rumford medal to Mr. Harrison the Academy are faithfully carrying out the expressed wishes of their benefactor, but also, that Mr. Harrison's invention is one which Count Rumford would have especially delighted to honor.

Professor Joseph Lovering then received the medal from the Chairman of the Rumford Committee, and presented it to Mr. John A. Coleman, who was delegated by Mr. Harrison to act as his substitute on the occasion, and presented it with these remarks: —

This full and authoritative statement of the Rumford Committee, which its Chairman has now presented, — covering as it does the whole ground, and clearly indicating the substantial reasons for the award of the Rumford Medal to Mr. Harrison, — renders further remarks from the Chair superfluous.

Acting by the request of your President, Dr. Asa Gray, who would not be able to speak this evening, even if it were safe for him to be present, I have only, in behalf of the Academy, to receive this medal from the Committee, who have so well done their part in producing it, and in justifying its bestowal, and to deliver it into the hands of the recipient's representative, since Mr. Harrison himself is unable to be with us upon this occasion.

As the founder of this premium was especially solicitous that it should stimulate those discoveries or inventions which tend to increase the comforts and conveniences of life, we may well conclude that he would regard with highest favor those that conduce to the preservation of life itself. The invention of Mr. Harrison is of this kind, is one which, it is thought, may render certain applications of heat, themselves of immeasurable importance, measurably secure, may render the steam-boiler for general mechanical purposes as safe as any other mode of generating power.

And now, Mr. Coleman, in the Academy's name, I deliver this gold medal, and its silver duplicate, to you, to be carefully transmitted by you to Mr. Joseph Harrison, Jr., whose name is inscribed upon them. The Secretaries will add an engrossed and attested copy of the proceedings of this meeting relative to the subject. Be pleased, my dear sir, to convey them to the hands of the gentleman whose invention the Academy desires to honor and to crown; and take with them to him the felicitations and the hearty good wishes of the Fellows of the American Academy of Arts and Sciences here assembled to administer Count Rumford's trust.

After Mr. Coleman had received the medals, he read the following response, directed to the President and Members of the American Academy of Arts and Sciences.

MR. PRESIDENT AND GENTLEMEN: —

In receiving the Rumford Medals, which have been awarded to me in so flattering a manner by the American Academy of Arts and Sciences, I fear that I cannot express in suitable terms my appreciation of this distinguished honor. I can, therefore, only say, that I do esteem this compliment very highly indeed, and I shall ever cherish these tokens with the greatest pride. To my mind, there is nothing within the limits of science at the present time that is of more importance than the "application of heat" to the safe generation of steam, and to have won a recognized distinction in such a field, and to have been deemed worthy of the reward that your honorable Society has bestowed upon me, fully repays me for many years of anxious, and often of discouraging, effort. In what I have done I claim but little merit beyond having called attention, for the last twelve years, to the great importance of the question, and in having in some degree demonstrated the fact that a Steam Generator can be made secure from destructive explosion. I think that this idea has now taken such a firm hold upon the public mind, both in this country and in Europe, that it may be fairly inferred that in the future the use of steam under pressure, no matter what form the apparatus may eventually assume, will not be attended with the disastrous results that are recorded in the past. In expressing my regret at being unable to attend your meeting on January 9th, so as to receive the medals in person, I most sincerely thank you, Mr. President and Members of the American Academy of Arts and Sciences, for this very high mark of your approbation.

JOSEPH HARRISON, JR.

Philadelphia, Jan. 6, 1872.

Professor E. C. Pickering exhibited a new form of dividing engine in which the scale to be engraved is moved forward equal amounts at each stroke, the distance being regulated by a pin moving between a plate of brass and the end of a screw. In this instrument, as there are no joints, this source of inaccuracy is avoided, and it is also free from the usual errors of a micrometer screw. The model shown, although made of pine-wood, gave results approaching in accuracy those of the best metal dividing engines.

Professor N. S. Shaler made a communication on the connection between the development of the life and the physical conditions of the several continents.

It has been shown that the several continents vary in the extent to which their shore line is irregular. If we arrange the several continents according to the amount of shore line compared with the internal area, we get a series in which they stand in the following order: Europe, North America, South America, Australia, Asia, Africa; but if we represent the continents in such a fashion that all have the same area, retaining for each the general outline which it now has, then we obtain a series in which Australia has the least shore in proportion to area, South America next, Africa and Asia next and approximately equal, North America next, and Europe the highest in the series, having several times as much shore line as Australia and much more than North America. It will be evident, on consideration, that this analysis enables us roughly to compare the conditions of surface on the several land masses. Those which have the largest amount of shore line in relation to area are those which have the most diversified surfaces, and conversely. With this series let us compare another series derived from the development of life on these continents. If we take these continents and tabulate their organic life, in so far as is necessary to determine the number of ancient types surviving on each, we may construct another series. It is true that this will be only approximative, but it will indicate the relative zoölogical inferiority of any continent, so far as we can infer that from the survival there of types of organic life which have disappeared from the others. This second series will correspond with the first, the continents being inferior as a whole in their organic development in proportion to the relative shortness of their shore lines: or, in other words, to the want of variety of their surfaces.

To see the connection between the development of life on the several continents and the variety of their outlines, it will be necessary to consider, from the point of view of Mr. Darwin, the difference between the conditions in which life is developed on two surfaces of equal area but *differing very widely as regards the irregularity of the surfaces.* In the first place, the irregularity of any extended land surface is in a general way a good measure of the number of important geological accidents to which the region has been subjected. There can be no question that Europe, the most varied of the continents in external surface, has many more distinct mountain systems than North America, the next in our series. Each of these "systems" is the mark of a wide-spread change of physical conditions which has brought important disturbances into the relations of the life by such accidents existing on sea and land. Many species would be extinguished, and, of those which survived, many would have to adapt themselves to new conditions, and so change and advance are made possible. Again, there is a direct and constant influence exercised by diversity of surface. The number of specific forms, and the consequent energy of the struggle for existence on any continent is, other things being equal, dependent upon the variety of conditions it offers to life. Compare two equal areas of, say, one hundred miles in extent, the one a level plain, the other thrown into a mountain mass, which extends from the tropics at the base to the frigid zone at its summit of perpetual snow. On the one you may find essentially the same organic forms throughout, and the competition is at the minimum; on the other, every mile of ascent brings you in contact with new forms, all the conditions of land life are crowded together, and their varied creatures put into such immediate contact that the struggle must be very much intensified. The seeds of plants belonging on the different zones, the insects which depend upon them, the many creatures dependent on the plant or insect life, are often swept by the streams or the winds, or forced by want of food into new conditions of life; cross-fertilization of plants and animals is far more likely to take place in these metropolitan centres of life than where the boundaries of species are made by barriers more insuperable than a mile of mountain slope.

Professor John Trowbridge presented the following remarks on Animal Electricity: —

The investigations of Du Bois Reymond, Matteuci, and others have left, apparently, no doubt of the existence of electrical currents in nerve and muscle.

Physiologists have been led from considering the anomalous contractions of the galvanoscopic frog to conclude that there exist in the muscles and nerves of man, of fishes, and in the various organs of the lower forms of life, currents which have determinate directions. The earlier investigators tested for the presence of these currents by touching the organs or parts to be examined with the bare terminals of the galvanometer; indeed, this method of investigation is still pursued by certain physiologists.

The evidence of the existence of animal currents produced by touching the muscles with the bare terminals of a galvanometer or an electrometer is entirely insufficient to prove that electrical currents circulate in the muscular or nerve tissues. One is baffled at every step by the dissimilar composition of the terminals; by the changes which they undergo from the action of the air upon the fluids adhering to the surface of the platinum; and by the influence of heat.

It is true that by experimenting with the bare terminals one can state a difference in the chemical nature of the different tissues of the muscle or nerve; we cannot, however, conclude that electrical currents exist in a determinate direction between such tissues; indeed, in many cases the galvanic action is evoked by the action of the metallic plates of the terminals. This unequal composition of the two electrodes can be overcome, as Matteuci has shown, by using amalgamated zinc terminals placed in a saturated solution of sulphate of zinc.

Du Bois Reymond, by using connecting pads of filtering-paper, saturated with the salt of the connecting liquid, with clay or bladder guards to prevent the muscle from coming in contact with the sulphate of zinc, was enabled to prosecute his investigations without fear of errors arising from the changes in the metallic terminals. At first sight it appears as if this method of experimenting left nothing to be desired. The sulphate of zinc is a good conductor; the zinc plates produce only a slight action when immersed in the sulphate of zinc, and this action can be readily compensated by a magnet or by a compensating current. The muscle can be touched at any part by the pads of filtering-paper or by the clay talons which Du Bois Reymond afterward used, without danger of injuring the animal tissue.

It occurred to me, however, from certain experiments upon the electromotive force arising from two liquids of a dissimilar chemical nature separated by a porous partition or by a membrane, that a serious error might arise in using even the pads or cushions of Du Bois Reymond, arising from the action of the vital fluids of the muscle upon the sulphate of zinc through the clay or membranous guards.

In experimenting upon the action through membranes I used an oblong vessel divided into four partitions by means of pieces of pig's bladder soaked in the white of an egg. In the outer compartments were placed the zinc electrodes in the solution of sulphate of zinc, and in the middle compartments the liquids to be examined. Owing to the unequal action of the sulphate of zinc through the partitions, even when the inner compartments were filled with one and the same liquid, an energetic swing of the needle of the galvanometer resulted.

The experiments with this apparatus made it evident that a very slight difference in the partitions enclosing a fluid and separating it from a surrounding homogeneous connecting liquid, together with the resulting endosmotic action, is sufficient to produce an electrical current.

I next made use of the apparatus of Du Bois Reymond, which I have already described. Having connected the two cushions by the connecting pad, and having laid a piece of bladder treated with the white of an egg over the connection thus formed, I made use of a series of tubes filled with the following liquids:

Distilled water.
Undistilled water.
Blood.
Solution of salt.
Solutions of iron.

Applying these tubes, having covered their openings with bladder, upon the connecting guard, I found that each liquid gave rise to a current which varied in direction with the nature of the fluid. These currents were evidently due to the action of the fluid in the artificial muscles upon the sulphate of zinc in the connecting guard, for distilled water gave no appreciable current, and the mere contact of the bladder of the tube upon the bladder of the guard was insufficient to produce an action. In order to be certain of this, I next made use of a vessel shaped like a U tube, with an opening at the bend, and having covered the ends of the tube with a membrane, I injected into the two limbs the liquids with which I experimented. When the vessel was filled with a homogeneous fluid, a deflection of the needle of the galvanometer was produced. Upon the reversal of the points of contact of the vessel with the guard, the direction of the needle was also reversed. That the current did not arise from the mere contact of the vessel with the guard was shown by applying its limbs unfilled with liquid; in this case no appreciable deflection of the needle resulted. That it arose from the action of two fluids separated by a membrane, one of them being the connecting liquid in which the cushions of the galvanometer were soaked, was evident by changing the composition of the liquid in the limbs of the U tube.

Desiring to test the direction of the current in order to see if it passed through the U tube, or merely, having arisen at the extremities of the tube, passed through the galvanometer back to its origin, I used an apparatus by means of which I was enabled to contract the section of one of the limbs of the U tube. This in all cases reduced the deflection of the needle in a marked manner, a complete constriction of the limb bringing the needle to rest.

My experiments led me to believe, that when the cushions of the galvanometer are connected by a membranous sac containing fluid, or animal tissue saturated with fluid, an endosmotic action takes place accompanied by a galvanic action; and that this galvanic action is determined by the difference of endosmotic action at various points of the enclosing membrane.

When, therefore, a muscle is laid upon the cushions with its transverse section upon one pad, and its longitudinal section upon the other, this difference of endosmotic action obtains, and a galvanic current results.

If the muscular and nerve currents exist, this endosmotic action must greatly modify their direction and strength. If they do not exist, the endosmotic action, or the electrical action of two fluids separated by a clay or membranous partition, is sufficient to produce currents which may be mistaken for the muscular currents, properly so called.

In order to study these phenomena, the same precautions must be taken as are advised by Du Bois Reymond (Untersuchungen über Thierische Electricität. Bd. I.: Beschreibung, etc., 1863, p. 95, *et seq.*) in the study of muscular currents. It must be considered that the fluids in the fresh muscle in their natural position are more energetic in their chemical nature than when they are taken from the muscle or nerve and experimented upon.

I used in my experiments one of Sir William Thompson's Reflecting Galvanometers, and also his new Quadrant Electrometer.

Six hundred and fortieth Meeting.

January 31, 1872. — STATED MEETING.

The PRESIDENT in the chair.

Professor N. S. Shaler called the attention of the Academy to the want of suitable rooms for their library and meetings, and suggested that better accommodations might be obtained in the building of the Boston Society of Natural History.

A Committee consisting of Messrs. Edmund Quincy, J. I. Bowditch, and N. S. Shaler, was appointed to consider this matter.

The following gentlemen were elected into the Academy: —

Charles A. Dunbar, of Cambridge, to be a Resident Fellow in Class III., Section 3.

William A. Rogers, of Cambridge, to be a Resident Fellow in Class I., Section 2.

Professor Crafts made some remarks on a new reaction, involving phosphorus, iodine, and the organic radical ethyl, in which the ethyl, contrary to the ideas held hitherto by most chemists, shows a stronger affinity for the phosphorus than does the iodine, setting the latter free and combining with the former to give a compound, from which the oxide of triethylphosphine can easily be obtained.

This result, which was realized by Mr. Emmerton in the laboratory of the Institute of Technology, was foreseen in a paper published in the "Journ. Chem. Soc." in 1871, by Messrs. Crafts and Silva.

Dr. Charles Pickering suggested that the story of Orpheus moving the rocks by his music might have originated from the method in which the Egyptians moved their immense masses of stone. Although some of them were ninety feet long and fourteen feet square, they were drawn by men, one of whom regulated the motions of the rest by standing on top and clapping his hands.

Professor Joseph Lovering made the following communication: —

On the 5th of October, 1793, the National Convention of France abolished the use of the Gregorian Calendar and established in its place the Republican Calendar.* A previous decree of the 22d September, 1792, had ordered that, after that day, all public acts should be dated from the first year of the Republic, without, however, changing the beginning of the year.† On the 24th of October,‡ a report was accepted which resulted in the decree of the 24th of November, when the details and nomenclature of the new calendar were adopted, and also the division of the day into 100,000 seconds. These decrees took effect from the 26th of November, 1793, when the new dates began to be used in recording the sessions and public acts of the Convention. So much as relates to the decimal division of the day was not obligatory until the first day of the year III., and was suspended in its operation, April 7, 1795. On the 8th of April, 1802, the week of seven days and their names were restored. On the 9th of September, 1805, an edict of Napoleon, upon the recommendation of a committee of which Laplace was chairman, ordered the restoration of the Gregorian Calendar on the 1st of January, 1806. It was asserted by Laplace, that the people of France had always adhered to the Gregorian reckoning, in common affairs from preference, and in ecclesiastical dates from necessity, and the expectation that any other nation would adopt the French innovation was a chimera.§

The Republican Calendar divided the year into twelve months of thirty days each. Four of these years make a Franciade, the last being called sextile, because it contained the extra day. The year which introduced the additional day was also called the Olympic. At the end of this year six *complementary* days were intercalated, and in other years only five. These *complementary* days were holidays, and were vulgarly called *Sansculottides;* also, *Épagomènes.*

The era of the new Chronology was antedated to the 22d of September, 1792, when the Republic was established and when the sun entered *Libra*, which was hailed as the symbol of equality. Each succeeding year must begin so that the equinox will occur some time during the first twenty-four hours. Though the names of the different months are derived from four different languages, they are narrowed in their meaning to the special climate of particular localities. If there were any good scientific reason for shifting the beginning of the year from the solstice to the equinox, only southern astronomers would have selected the autumnal equinox.*

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* Dictionnaire Général de la Politique, par Block, p. 301. Dictionnaire de l'Administration Française, p. 293. National Cyclopedia, VII., p. 690. Arago. Astronomie, IV., pp. 667-701. Ideler. Handbuch der Chronologie, II., pp. 468-470. Companion to the British Almanac for 1828, p. 5, and 1830, pp. 19, 20.

† Choix de Rapports, Opinions, et Discours, etc., X., p. 24.

‡ Le procès-verbal du lendemain, 25 October, porte le date du 4 Frimaire de l'an II. de la République Française. Ibid., XIII. p. 96.

§ Choix de Rapports, Opinions, et Discours, XIX. 191-199.

Of the Republican Calendar, the late John Quincy Adams said: "This system has passed away and is forgotten. This incongruous composition of profound learning and superficial frivolity, of irreligion and morality, of delicate imagination and coarse vulgarity, is dissolved." Unfortunately the effects of this calendar, though it was used for only about twelve years, have not passed away. It has entailed a permanent injury on history and on science. The conversion of the Julian and Gregorian reckonings into each other is comparatively simple It is done by adding or subtracting a quantity so constant that it only changes three times in the course of four hundred years. But the reduction of Republican dates into Gregorian style is more perplexing, especially if it must be done on the sudden, when the mind is absorbed in other studies. The only sufficient remedy is a full concordance for every one of the forty-four hundred and nineteen days during which the revolutionary calendar was used. Mr. John J. Bond † has made some approach to this by printing the Gregorian dates for the first and last days of each month of the Republican Calendar, and also the Republican dates for the first and last days of each Gregorian month. But, unhappily, he has been led into error, even in this partial reduction, by supposing that the years IV., and VIII., and XII., of the new era were leap years *in fact*, because they were called *sextile* or the last of the Franciades. It appears, however, by the *Connaissance des Tems*, that the extra day was introduced at the end of the years III., and VII., and XI., corresponding to September 22, 1795, September 22, 1799, and September 22, 1803. Consequently there must be an error of one day in Bond's Tables for the years IV., and VIII., and XII., of the Republican era.

The Bureau of Longitudes, established by a law of June 25, 1795 (Messidor 7, An III.), was charged by Article IX. of its regulations with the duty of presenting, each year, to the Legislative Body an

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* Delambre. Astronomie, III., p. 696.

† Handy Book of Rules and Tables, pp. 102 – 112.

Annual as a guide for the whole Republic. In one of the volumes * I read as follows: "Chaque année commence à minuit avec le jour dans lequel arrive l'équinoxe vrai d'automne, à Paris. D'après cette règle, les années III., VII., XI., etc., doivent être sextiles, c'est-à-dire avoir six jours complémentaires. On trouvera la table dans le Manuel républicain."

Mr. Bond was probably led into his mistake by assuming that the first Franciade began with the first year of the French Republic. It appears, however, from the instructions drawn up by Romme, in behalf of the Committee of Public Instruction, to assist in the introduction of the new system with the people, that the first year of the first Franciade was the year preceding the first year of the Republic; and for the following reason, given in his own words: "La première année de l'ère nouvelle commencerait une nouvelle période de quatre ans si Jules César et Grégoire XIII., en plaçant la bissextile, avaient moins consulté leur orgueil que la rigueur de la concordance astronomique, et si jusqu'à présent nous n'avions été les serviles imitateurs des Romains. La raison veut que nous suivions la nature, plutôt que de nous traîner servilement sur les traces erronées de nos prédécesseurs: nous devons donc fixer invariablement notre jour intercalaire dans l'année que la position de l'équinoxe d'automne comportera. Après une première disposition que la concordance avec les observations astronomiques rend nécessaire, la période sera de quatre ans," etc. And again: "La seconde table fait connaître l'ordre des Franciades; on y voit que nous sommes à la troisième année de la première Franciade." † This document bears the date of Frimaire 4, de l'an II. (November 24, 1793).

Therefore, the first Franciade ended with the *third* year of the Republic, and the extra day was introduced at the end of this year. Inasmuch, therefore, as there is great liability to mistakes, not only in reducing scattered dates from the French Republican calendar into the Gregorian calendar, and back again from the latter into the former, but also in the construction of a partial concordance, I have thought the calculation and publication of a full concordance to be not a superfluous task, especially since the early and lamentable failure of the new system allows it to be brought within the compass of a dozen pages.

It was voted that these tables be published in the Proceedings of the Academy.

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* Annuaire de la République Française pour l'année VII. de l'ère Française, p. 34.

† Choix de Rapports, Opinions, et Discours, etc., XIII., 104, 105.

Vendémiaire, or Vintage-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
	1793.	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	Sept. 22	Sept. 22	Sept. 23	Sept. 22	Sept. 22	Sept. 22	Sept. 23	Sept. 23	Sept. 23	Sept. 23	Sept. 24	Sept. 23	Sept. 23
2	23	23	24	23	23	23	24	24	24	24	25	24	24
3	24	24	25	24	24	24	25	25	25	25	26	25	25
4	25	25	26	25	25	25	26	26	26	26	27	26	26
5	26	26	27	26	26	26	27	27	27	27	28	27	27
6	27	27	28	27	27	27	28	28	28	28	29	28	28
7	28	28	29	28	28	28	29	29	29	29	30	29	29
8	29	29	30	29	29	29	30	30	30	30	Oct. 1	30	30
9	30	30	Oct. 1	30	30	30	Oct. 1	Oct. 1	Oct. 1	Oct. 1	2	Oct. 1	Oct. 1
10	Oct. 1	Oct. 1	2	Oct. 1	Oct. 1	Oct. 1	2	2	2	2	3	2	2
11	2	2	3	2	2	2	3	3	3	3	4	3	3
12	3	3	4	3	3	3	4	4	4	4	5	4	4
13	4	4	5	4	4	4	5	5	5	5	6	5	5
14	5	5	6	5	5	5	6	6	6	6	7	6	6
15	6	6	7	6	6	6	7	7	7	7	8	7	7
16	7	7	8	7	7	7	8	8	8	8	9	8	8
17	8	8	9	8	8	8	9	9	9	9	10	9	9
18	9	9	10	9	9	9	10	10	10	10	11	10	10
19	10	10	11	10	10	10	11	11	11	11	12	11	11
20	11	11	12	11	11	11	12	12	12	12	13	12	12
21	12	12	13	12	12	12	13	13	13	13	14	13	13
22	13	13	14	13	13	13	14	14	14	14	15	14	14
23	14	14	15	14	14	14	15	15	15	15	16	15	15
24	15	15	16	15	15	15	16	16	16	16	17	16	16
25	16	16	17	16	16	16	17	17	17	17	18	17	17
26	17	17	18	17	17	17	18	18	18	18	19	18	18
27	18	18	19	18	18	18	19	19	19	19	20	19	19
28	19	19	20	19	19	19	20	20	20	20	21	20	20
29	20	20	21	20	20	20	21	21	21	21	22	21	21
30	21	21	22	21	21	21	22	22	22	22	23	22	22

Brumaire, or Fog-Month.

Day.	II. 1793.	III. 1794.	IV. 1795.	V. 1796.	VI. 1797.	VII. 1798.	VIII. 1799.	IX. 1800.	X. 1801.	XI. 1802.	XII. 1803.	XIII. 1804.	XIV. 1805.
1	Oct. 22	Oct. 22	Oct. 23	Oct. 22	Oct. 22	Oct. 22	Oct. 23	Oct. 23	Oct. 23	Oct. 23	Oct. 24	Oct. 23	Oct. 23
2	23	23	24	23	23	23	24	24	24	24	25	24	24
3	24	24	25	24	24	24	25	25	25	25	26	25	25
4	25	25	26	25	25	25	26	26	26	26	27	26	26
5	26	26	27	26	26	26	27	27	27	27	28	27	27
6	27	27	28	27	27	27	28	28	28	28	29	28	28
7	28	28	29	28	28	28	29	29	29	29	30	29	29
8	29	29	30	29	29	29	30	30	30	30	31	30	30
9	30	30	31	30	30	30	31	31	31	31	Nov. 1	31	31
10	31	31	Nov. 1	31	31	31	Nov. 1	Nov. 1	Nov. 1	Nov. 1	2	Nov. 1	Nov. 1
11	Nov. 1	Nov. 1	2	Nov. 1	Nov. 1	Nov. 1	2	2	2	2	3	2	2
12	2	2	3	2	2	2	3	3	3	3	4	3	3
13	3	3	4	3	3	3	4	4	4	4	5	4	4
14	4	4	5	4	4	4	5	5	5	5	6	5	5
15	5	5	6	5	5	5	6	6	6	6	7	6	6
16	6	6	7	6	6	6	7	7	7	7	8	7	7
17	7	7	8	7	7	7	8	8	8	8	9	8	8
18	8	8	9	8	8	8	9	9	9	9	10	9	9
19	9	9	10	9	9	9	10	10	10	10	11	10	10
20	10	10	11	10	10	10	11	11	11	11	12	11	11
21	11	11	12	11	11	11	12	12	12	12	13	12	12
22	12	12	13	12	12	12	13	13	13	13	14	13	13
23	13	13	14	13	13	13	14	14	14	14	15	14	14
24	14	14	15	14	14	14	15	15	15	15	16	15	15
25	15	15	16	15	15	15	16	16	16	16	17	16	16
26	16	16	17	16	16	16	17	17	17	17	18	17	17
27	17	17	18	17	17	17	18	18	18	18	19	18	18
28	18	18	19	18	18	18	19	19	19	19	20	19	19
29	19	19	20	19	19	19	20	20	20	20	21	20	20
30	20	20	21	20	20	20	21	21	21	21	22	21	21

Frimaire, or Frost-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
	1793.	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	Nov. 21	Nov. 21	Nov. 22	Nov. 21	Nov. 21	Nov. 21	Nov. 22	Nov. 22	Nov. 22	Nov. 22	Nov. 23	Nov. 22	Nov. 22
2	22	22	23	22	22	22	23	23	23	23	24	23	23
3	23	23	24	23	23	23	24	24	24	24	25	24	24
4	24	24	25	24	24	24	25	25	25	25	26	25	25
5	25	25	26	25	25	25	26	26	26	26	27	26	26
6	26	26	27	26	26	26	27	27	27	27	28	27	27
7	27	27	28	27	27	27	28	28	28	28	29	28	28
8	28	28	29	28	28	28	29	29	29	29	30	29	29
9	29	29	30	29	29	29	30	30	30	30	Dec. 1	30	30
10	30	30	Dec. 1	30	30	30	Dec. 1	Dec. 1	Dec. 1	Dec. 1	2	Dec. 1	Dec. 1
11	Dec. 1	Dec. 1	2	Dec. 1	Dec. 1	Dec. 1	2	2	2	2	3	2	2
12	2	2	3	2	2	2	3	3	3	3	4	3	3
13	3	3	4	3	3	3	4	4	4	4	5	4	4
14	4	4	5	4	4	4	5	5	5	5	6	5	5
15	5	5	6	5	5	5	6	6	6	6	7	6	6
16	6	6	7	6	6	6	7	7	7	7	8	7	7
17	7	7	8	7	7	7	8	8	8	8	9	8	8
18	8	8	9	8	8	8	9	9	9	9	10	9	9
19	9	9	10	9	9	9	10	10	10	10	11	10	10
20	10	10	11	10	10	10	11	11	11	11	12	11	11
21	11	11	12	11	11	11	12	12	12	12	13	12	12
22	12	12	13	12	12	12	13	13	13	13	14	13	13
23	13	13	14	13	13	13	14	14	14	14	15	14	14
24	14	14	15	14	14	14	15	15	15	15	16	15	15
25	15	15	16	15	15	15	16	16	16	16	17	16	16
26	16	16	17	16	16	16	17	17	17	17	18	17	17
27	17	17	18	17	17	17	18	18	18	18	19	18	18
28	18	18	19	18	18	18	19	19	19	19	20	19	19
29	19	19	20	19	19	19	20	20	20	20	21	20	20
30	20	20	21	20	20	20	21	21	21	21	22	21	21

Nivôse, or Snow-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
	1793.	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	Dec. 21	Dec. 21	Dec. 22	Dec. 21	Dec. 21	Dec. 21	Dec. 22	Dec. 22	Dec. 22	Dec. 22	Dec. 23	Dec. 22	Dec. 22
2	22	22	23	22	22	22	23	23	23	23	24	23	23
3	23	23	24	23	23	23	24	24	24	24	25	24	24
4	24	24	25	24	24	24	25	25	25	25	26	25	25
5	25	25	26	25	25	25	26	26	26	26	27	26	26
6	26	26	27	26	26	26	27	27	27	27	28	27	27
7	27	27	28	27	27	27	28	28	28	28	29	28	28
8	28	28	29	28	28	28	29	29	29	29	30	29	29
9	29	29	30	29	29	29	30	30	30	30	31	30	30
10	30	30	31	30	30	30	31	31	31	31	1804. Jan. 1	31	31
11	31	31	1796. Jan. 1	31	31	31	1800. Jan. 1	1801. Jan. 1	1802. Jan. 1	1803. Jan. 1	2	1805. Jan. 1	
12	1794. Jan. 1	1795. Jan. 1	2	1797. Jan. 1	1798. Jan. 1	1799. Jan. 1	2	2	2	2	3	2	
13	2	2	3	2	2	2	3	3	3	3	4	3	
14	3	3	4	3	3	3	4	4	4	4	5	4	
15	4	4	5	4	4	4	5	5	5	5	6	5	
16	5	5	6	5	5	5	6	6	6	6	7	6	
17	6	6	7	6	6	6	7	7	7	7	8	7	
18	7	7	8	7	7	7	8	8	8	8	9	8	
19	8	8	9	8	8	8	9	9	9	9	10	9	
20	9	9	10	9	9	9	10	10	10	10	11	10	
21	10	10	11	10	10	10	11	11	11	11	12	11	
22	11	11	12	11	11	11	12	12	12	12	13	12	
23	12	12	13	12	12	12	13	13	13	13	14	13	
24	13	13	14	13	13	13	14	14	14	14	15	14	
25	14	14	15	14	14	14	15	15	15	15	16	15	
26	15	15	16	15	15	15	16	16	16	16	17	16	
27	16	16	17	16	16	16	17	17	17	17	18	17	
28	17	17	18	17	17	17	18	18	18	18	19	18	
29	18	18	19	18	18	18	19	19	19	19	20	19	
30	19	19	20	19	19	19	20	20	20	20	21	20	

Pluviôse, or Rain-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	Jan. 20	Jan. 20	Jan. 21	Jan. 20	Jan. 20	Jan. 20	Jan. 21	Jan. 21	Jan. 21	Jan. 21	Jan. 22	Jan. 21
2	21	21	22	21	21	21	22	22	22	22	23	22
3	22	22	23	22	22	22	23	23	23	23	24	23
4	23	23	24	23	23	23	24	24	24	24	25	24
5	24	24	25	24	24	24	25	25	25	25	26	25
6	25	25	26	25	25	25	26	26	26	26	27	26
7	26	26	27	26	26	26	27	27	27	27	28	27
8	27	27	28	27	27	27	28	28	28	28	29	28
9	28	28	29	28	28	28	29	29	29	29	30	29
10	29	29	30	29	29	29	30	30	30	30	31	30
11	30	30	31	30	30	30	31	31	31	31	Feb. 1	31
12	31	31	Feb. 1	31	31	31	Feb. 1	Feb. 1	Feb. 1	Feb. 1	2	Feb. 1
13	Feb. 1	Feb. 1	2	Feb. 1	Feb. 1	Feb. 1	2	2	2	2	3	2
14	2	2	3	2	2	2	3	3	3	3	4	3
15	3	3	4	3	3	3	4	4	4	4	5	4
16	4	4	5	4	4	4	5	5	5	5	6	5
17	5	5	6	5	5	5	6	6	6	6	7	6
18	6	6	7	6	6	6	7	7	7	7	8	7
19	7	7	8	7	7	7	8	8	8	8	9	8
20	8	8	9	8	8	8	9	9	9	9	10	9
21	9	9	10	9	9	9	10	10	10	10	11	10
22	10	10	11	10	10	10	11	11	11	11	12	11
23	11	11	12	11	11	11	12	12	12	12	13	12
24	12	12	13	12	12	12	13	13	13	13	14	13
25	13	13	14	13	13	13	14	14	14	14	15	14
26	14	14	15	14	14	14	15	15	15	15	16	15
27	15	15	16	15	15	15	16	16	16	16	17	16
28	16	16	17	16	16	16	17	17	17	17	18	17
29	17	17	18	17	17	17	18	18	18	18	19	18
30	18	18	19	18	18	18	19	19	19	19	20	19

Ventôse, or Wind-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	Feb. 19	Feb. 19	Feb. 20	Feb. 19	Feb. 19	Feb. 19	Feb. 20	Feb. 20	Feb. 20	Feb. 20	Feb. 21	Feb. 20
2	20	20	21	20	20	20	21	21	21	21	22	21
3	21	21	22	21	21	21	22	22	22	22	23	22
4	22	22	23	22	22	22	23	23	23	23	24	23
5	23	23	24	23	23	23	24	24	24	24	25	24
6	24	24	25	24	24	24	25	25	25	25	26	25
7	25	25	26	25	25	25	26	26	26	26	27	26
8	26	26	27	26	26	26	27	27	27	27	28	27
9	27	27	28	27	27	27	28	28	28	28	29	28
10	28	28	29	28	28	28	Mar. 1	Mar. 1	Mar. 1	Mar. 1	Mar. 1	Mar. 1
11	Mar. 1	Mar. 1	Mar. 1	Mar. 1	Mar. 1	Mar. 1	2	2	2	2	2	2
12	2	2	2	2	2	2	3	3	3	3	3	3
13	3	3	3	3	3	3	4	4	4	4	4	4
14	4	4	4	4	4	4	5	5	5	5	5	5
15	5	5	5	5	5	5	6	6	6	6	6	6
16	6	6	6	6	6	6	7	7	7	7	7	7
17	7	7	7	7	7	7	8	8	8	8	8	8
18	8	8	8	8	8	8	9	9	9	9	9	9
19	9	9	9	9	9	9	10	10	10	10	10	10
20	10	10	10	10	10	10	11	11	11	11	11	11
21	11	11	11	11	11	11	12	12	12	12	12	12
22	12	12	12	12	12	12	13	13	13	13	13	13
23	13	13	13	13	13	13	14	14	14	14	14	14
24	14	14	14	14	14	14	15	15	15	15	15	15
25	15	15	15	15	15	15	16	16	16	16	16	16
26	16	16	16	16	16	16	17	17	17	17	17	17
27	17	17	17	17	17	17	18	18	18	18	18	18
28	18	18	18	18	18	18	19	19	19	19	19	19
29	19	19	19	19	19	19	20	20	20	20	20	20
30	20	20	20	20	20	20	21	21	21	21	21	21

Germinal, or Bud-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	Mar. 21	Mar. 21	Mar. 21	Mar. 21	Mar. 21	Mar. 21	Mar. 22	Mar. 22	Mar. 22	Mar. 22	Mar. 22	Mar. 22
2	22	22	22	22	22	22	23	23	23	23	23	23
3	23	23	23	23	23	23	24	24	24	24	24	24
4	24	24	24	24	24	24	25	25	25	25	25	25
5	25	25	25	25	25	25	26	26	26	26	26	26
6	26	26	26	26	26	26	27	27	27	27	27	27
7	27	27	27	27	27	27	28	28	28	28	28	28
8	28	28	28	28	28	28	29	29	29	29	29	29
9	29	29	29	29	29	29	30	30	30	30	30	30
10	30	30	30	30	30	30	31	31	31	31	31	31
11	31	31	31	31	31	31	April. 1	April. 1	April. 1	April. 1	April. 1	April. 1
12	April. 1	April. 1	April. 1	April. 1	April. 1	April. 1	2	2	2	2	2	2
13	2	2	2	2	2	2	3	3	3	3	3	3
14	3	3	3	3	3	3	4	4	4	4	4	4
15	4	4	4	4	4	4	5	5	5	5	5	5
16	5	5	5	5	5	5	6	6	6	6	6	6
17	6	6	6	6	6	6	7	7	7	7	7	7
18	7	7	7	7	7	7	8	8	8	8	8	8
19	8	8	8	8	8	8	9	9	9	9	9	9
20	9	9	9	9	9	9	10	10	10	10	10	10
21	10	10	10	10	10	10	11	11	11	11	11	11
22	11	11	11	11	11	11	12	12	12	12	12	12
23	12	12	12	12	12	12	13	13	13	13	13	13
24	13	13	13	13	13	13	14	14	14	14	14	14
25	14	14	14	14	14	14	15	15	15	15	15	15
26	15	15	15	15	15	15	16	16	16	16	16	16
27	16	16	16	16	16	16	17	17	17	17	17	17
28	17	17	17	17	17	17	18	18	18	18	18	18
29	18	18	18	18	18	18	19	19	19	19	19	19
30	19	19	19	19	19	19	20	20	20	20	20	20

Floréal, or Flower-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	April. 20	April. 20	April. 20	April. 20	April. 20	April. 20	April. 21	April. 21	April. 21	April. 21	April. 21	April. 21
2	21	21	21	21	21	21	22	22	22	22	22	22
3	22	22	22	22	22	22	23	23	23	23	23	23
4	23	23	23	23	23	23	24	24	24	24	24	24
5	24	24	24	24	24	24	25	25	25	25	25	25
6	25	25	25	25	25	25	26	26	26	26	26	26
7	26	26	26	26	26	26	27	27	27	27	27	27
8	27	27	27	27	27	27	28	28	28	28	28	28
9	28	28	28	28	28	28	29	29	29	29	29	29
10	29	29	29	29	29	29	30	30	30	30	30	30
11	30	30	30	30	30	30	May. 1	May. 1	May. 1	May. 1	May. 1	May. 1
12	May. 1	May. 1	May. 1	May. 1	May. 1	May. 1	2	2	2	2	2	2
13	2	2	2	2	2	2	3	3	3	3	3	3
14	3	3	3	3	3	3	4	4	4	4	4	4
15	4	4	4	4	4	4	5	5	5	5	5	5
16	5	5	5	5	5	5	6	6	6	6	6	6
17	6	6	6	6	6	6	7	7	7	7	7	7
18	7	7	7	7	7	7	8	8	8	8	8	8
19	8	8	8	8	8	8	9	9	9	9	9	9
20	9	9	9	9	9	9	10	10	10	10	10	10
21	10	10	10	10	10	10	11	11	11	11	11	11
22	11	11	11	11	11	11	12	12	12	12	12	12
23	12	12	12	12	12	12	13	13	13	13	13	13
24	13	13	13	13	13	13	14	14	14	14	14	14
25	14	14	14	14	14	14	15	15	15	15	15	15
26	15	15	15	15	15	15	16	16	16	16	16	16
27	16	16	16	16	16	16	17	17	17	17	17	17
28	17	17	17	17	17	17	18	18	18	18	18	18
29	18	18	18	18	18	18	19	19	19	19	19	19
30	19	19	19	19	19	19	20	20	20	20	20	20

Prairial, or Pasture-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	May. 20	May. 20	May. 20	May. 20	May. 20	May. 20	May. 21	May. 21	May. 21	May. 21	May. 21	May. 21
2	21	21	21	21	21	21	22	22	22	22	22	22
3	22	22	22	22	22	22	23	23	23	23	23	23
4	23	23	23	23	23	23	24	24	24	24	24	24
5	24	24	24	24	24	24	25	25	25	25	25	25
6	25	25	25	25	25	25	26	26	26	26	26	26
7	26	26	26	26	26	26	27	27	27	27	27	27
8	27	27	27	27	27	27	28	28	28	28	28	28
9	28	28	28	28	28	28	29	29	29	29	29	29
10	29	29	29	29	29	29	30	30	30	30	30	30
11	30	30	30	30	30	30	31	31	31	31	31	31
12	31	31	31	31	31	31	June. 1	June. 1	June. 1	June. 1	June. 1	June. 1
13	June. 1	June. 1	June. 1	June. 1	June. 1	June. 1	2	2	2	2	2	2
14	2	2	2	2	2	2	3	3	3	3	3	3
15	3	3	3	3	3	3	4	4	4	4	4	4
16	4	4	4	4	4	4	5	5	5	5	5	5
17	5	5	5	5	5	5	6	6	6	6	6	6
18	6	6	6	6	6	6	7	7	7	7	7	7
19	7	7	7	7	7	7	8	8	8	8	8	8
20	8	8	8	8	8	8	9	9	9	9	9	9
21	9	9	9	9	9	9	10	10	10	10	10	10
22	10	10	10	10	10	10	11	11	11	11	11	11
23	11	11	11	11	11	11	12	12	12	12	12	12
24	12	12	12	12	12	12	13	13	13	13	13	13
25	13	13	13	13	13	13	14	14	14	14	14	14
26	14	14	14	14	14	14	15	15	15	15	15	15
27	15	15	15	15	15	15	16	16	16	16	16	16
28	16	16	16	16	16	16	17	17	17	17	17	17
29	17	17	17	17	17	17	18	18	18	18	18	18
30	18	18	18	18	18	18	19	19	19	19	19	19

Messidor, or Harvest-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	June. 19	June. 19	June. 19	June. 19	June. 19	June. 19	June. 20	June. 20	June. 20	June. 20	June. 20	June. 20
2	20	20	20	20	20	20	21	21	21	21	21	21
3	21	21	21	21	21	21	22	22	22	22	22	22
4	22	22	22	22	22	22	23	23	23	23	23	23
5	23	23	23	23	23	23	24	24	24	24	24	24
6	24	24	24	24	24	24	25	25	25	25	25	25
7	25	25	25	25	25	25	26	26	26	26	26	26
8	26	26	26	26	26	26	27	27	27	27	27	27
9	27	27	27	27	27	27	28	28	28	28	28	28
10	28	28	28	28	28	28	29	29	29	29	29	29
11	29	29	29	29	29	29	30	30	30	30	30	30
12	30	30	30	30	30	30	July. 1	July. 1	July. 1	July. 1	July. 1	July. 1
13	July. 1	July. 1	July. 1	July. 1	July. 1	July. 1	2	2	2	2	2	2
14	2	2	2	2	2	2	3	3	3	3	3	3
15	3	3	3	3	3	3	4	4	4	4	4	4
16	4	4	4	4	4	4	5	5	5	5	5	5
17	5	5	5	5	5	5	6	6	6	6	6	6
18	6	6	6	6	6	6	7	7	7	7	7	7
19	7	7	7	7	7	7	8	8	8	8	8	8
20	8	8	8	8	8	8	9	9	9	9	9	9
21	9	9	9	9	9	9	10	10	10	10	10	10
22	10	10	10	10	10	10	11	11	11	11	11	11
23	11	11	11	11	11	11	12	12	12	12	12	12
24	12	12	12	12	12	12	13	13	13	13	13	13
25	13	13	13	13	13	13	14	14	14	14	14	14
26	14	14	14	14	14	14	15	15	15	15	15	15
27	15	15	15	15	15	15	16	16	16	16	16	16
28	16	16	16	16	16	16	17	17	17	17	17	17
29	17	17	17	17	17	17	18	18	18	18	18	18
30	18	18	18	18	18	18	19	19	19	19	19	19

Thermidor, or Heat-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	July. 19	July. 19	July. 19	July. 19	July. 19	July. 19	July. 20	July. 20	July. 20	July. 20	July. 20	July. 20
2	20	20	20	20	20	20	21	21	21	21	21	21
3	21	21	21	21	21	21	22	22	22	22	22	22
4	22	22	22	22	22	22	23	23	23	23	23	23
5	23	23	23	23	23	23	24	24	24	24	24	24
6	24	24	24	24	24	24	25	25	25	25	25	25
7	25	25	25	25	25	25	26	26	26	26	26	26
8	26	26	26	26	26	26	27	27	27	27	27	27
9	27	27	27	27	27	27	28	28	28	28	28	28
10	28	28	28	28	28	28	29	29	29	29	29	29
11	29	29	29	29	29	29	30	30	30	30	30	30
12	30	30	30	30	30	30	31	31	31	31	31	31
13	31	31	31	31	31	31	Aug. 1	Aug. 1	Aug. 1	Aug. 1	Aug. 1	Aug. 1
14	Aug. 1	Aug. 1	Aug. 1	Aug. 1	Aug. 1	Aug. 1	2	2	2	2	2	2
15	2	2	2	2	2	2	3	3	3	3	3	3
16	3	3	3	3	3	3	4	4	4	4	4	4
17	4	4	4	4	4	4	5	5	5	5	5	5
18	5	5	5	5	5	5	6	6	6	6	6	6
19	6	6	6	6	6	6	7	7	7	7	7	7
20	7	7	7	7	7	7	8	8	8	8	8	8
21	8	8	8	8	8	8	9	9	9	9	9	9
22	9	9	9	9	9	9	10	10	10	10	10	10
23	10	10	10	10	10	10	11	11	11	11	11	11
24	11	11	11	11	11	11	12	12	12	12	12	12
25	12	12	12	12	12	12	13	13	13	13	13	13
26	13	13	13	13	13	13	14	14	14	14	14	14
27	14	14	14	14	14	14	15	15	15	15	15	15
28	15	15	15	15	15	15	16	16	16	16	16	16
29	16	16	16	16	16	16	17	17	17	17	17	17
30	17	17	17	17	17	17	18	18	18	18	18	18

Fructidor, or Fruit-Month.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
1	Aug. 18	Aug. 18	Aug. 18	Aug. 18	Aug. 18	Aug. 18	Aug. 19	Aug. 19	Aug. 19	Aug. 19	Aug. 19	Aug. 19
2	19	19	19	19	19	19	20	20	20	20	20	20
3	20	20	20	20	20	20	21	21	21	21	21	21
4	21	21	21	21	21	21	22	22	22	22	22	22
5	22	22	22	22	22	22	23	23	23	23	23	23
6	23	23	23	23	23	23	24	24	24	24	24	24
7	24	24	24	24	24	24	25	25	25	25	25	25
8	25	25	25	25	25	25	26	26	26	26	26	26
9	26	26	26	26	26	26	27	27	27	27	27	27
10	27	27	27	27	27	27	28	28	28	28	28	28
11	28	28	28	28	28	28	29	29	29	29	29	29
12	29	29	29	29	29	29	30	30	30	30	30	30
13	30	30	30	30	30	30	31	31	31	31	31	31
14	31	31	31	31	31	31	Sept. 1	Sept. 1	Sept. 1	Sept. 1	Sept. 1	Sept. 1
15	Sept. 1	Sept. 1	Sept. 1	Sept. 1	Sept. 1	Sept. 1	2	2	2	2	2	2
16	2	2	2	2	2	2	3	3	3	3	3	3
17	3	3	3	3	3	3	4	4	4	4	4	4
18	4	4	4	4	4	4	5	5	5	5	5	5
19	5	5	5	5	5	5	6	6	6	6	6	6
20	6	6	6	6	6	6	7	7	7	7	7	7
21	7	7	7	7	7	7	8	8	8	8	8	8
22	8	8	8	8	8	8	9	9	9	9	9	9
23	9	9	9	9	9	9	10	10	10	10	10	10
24	10	10	10	10	10	10	11	11	11	11	11	11
25	11	11	11	11	11	11	12	12	12	12	12	12
26	12	12	12	12	12	12	13	13	13	13	13	13
27	13	13	13	13	13	13	14	14	14	14	14	14
28	14	14	14	14	14	14	15	15	15	15	15	15
29	15	15	15	15	15	15	16	16	16	16	16	16
30	16	16	16	16	16	16	17	17	17	17	17	17

Complementary Days.

Day.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.
	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.	Sept.
1*	17	17	17	17	17	17	18	18	18	18	18	18
2	18	18	18	18	18	18	19	19	19	19	19	19
3	19	19	19	19	19	19	20	20	20	20	20	20
4	20	20	20	20	20	20	21	21	21	21	21	21
5	21	21	21	21	21	21	22	22	22	22	22	22
6		22				22				23		

* Complementary days, or Sansculottides, called *Primidi, Duodi, Tridi, Quartidi, Quintidi,* and *Sextidi.* These days were not considered as belonging to any month. The sonorous names given to the months by the innovators have been freely translated thus : —

Wheezy,
Sneezy,
Breezy.

Slippy,
Drippy,
Nippy.

Showery,
Flowery,
Bowery.

Hoppy,
Croppy,
Poppy.

Chambers's Descriptive Astronomy, p. 443.

Six hundred and forty-first Meeting.

February 13, 1872. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

Professor John Trowbridge remarked : —

While experimenting upon the electromotive action of fluids separated by membranes, I was led to reflect upon the surface action observed by Tomlinson, and to examine it from an electrical point of view. I made use of a bath of sulphate of zinc in which were placed the amalgamated zinc terminals of a galvanometer. On dropping liquids upon the surface of this bath electrical currents were produced, but they were not due to surface action ; for, on using a drop of colored liquid, the deflection of the galvanometer was observed before the liquid reached the terminals. This was also proved by coating the plates of the terminals with parafine, with the exception of a narrow strip two inches below the surface of the bath.

The President communicated the following: —

Botanical Contributions by ASA GRAY.

1. *Notes on Labiatæ.*

At the close of a preceding article (see vol. 8, pp. 294 – 296) two new genera of Labiatæ were described. I now offer additional notes upon one of these genera, and upon some other plants of the order, being such of the results of a recent revision of the North American species as seem worth while to be now recorded.

POLIOMINTHA, Gray, in Proc. Am. Acad. 8, p. 295. — The two species on which the genus was founded, *P. incana* and *P. longiflora*, have corolla intus piloso-annulata; calycis dentes erecti. A second section has to be added: viz.

§ 2. Corolla exannulata: calycis dentes nunc patentes. *Keithiæ* affinius sed staminum superiorum filamenta sterilia conspicuæ.

P. MARIFOLIA. *Keithia marifolia* Schauer, Linnæa, 20, p. 705. If Coulter's no. 1080 be rightly here referred, the species is well marked by its roundish-ovate leaves with diverging veins, and its erect calyx-teeth one third to one fourth the length of the tube; rudimentary filaments filiform. The calyx is obscurely bilabiate.

P. MOLLIS. Tomentoso-incana, basi tantum lignescente; foliis ovatis ovalibusque 3 – 5-plinerviis basi in petiolum brevem angustatis; calycis dentibus subinæqualibus tubo angusto 13-nervi quadruplo brevioribus inæqualiter patentibus; corolla calycem duplo superantibus; rudimentis staminum superiorum brevibus subulatis. *Hedeoma mollis* Torr. Mex. Bound. p. 129 (char. vix bona). — S. W. Texas; cliffs on the Rio Grande near Puerte de Paysano, Dr. Bigelow.

CUNILA MARIANA L. The genus *Cunila*, of which this species is the type, ever since its reformation by Bentham more than 30 years ago, has been characterized as diandrous with no vestiges of the superior pair of stamens. Bentham cites the figure in Sweet, Brit. Flower Garden, t. 243, without noticing that it represents, and the letterpress describes, a rather conspicuous capitellate-tipped pair of rudimentary stamens, probably supposing this to be incorrect. It is, however, only an exaggeration; for, as Professor Buckhout of Pennsylvania Agricultural College has shown me, minute rudimentary sterile filaments are uniformly present in our species. If truly absent in the Mexican and Brazilian species, the value of this character as a generic one is re-

duced, and by analogy a leading distinction of the preceding genus considerably invalidated.

HEDEOMA Pers. — Under EUHEDEOMA, I arrange our species as follows,

* Filamenta stam. sup. conspicua antheram abortivam capitellatam nunc vix imperfectam gerentia: calyx egregie bilabiatus, labiis difformibus.

H. PULEGIOIDES Pers. — Cis-Mississippiana.

* * Filamenta superiora aut minuta subulata nuda, aut obsoleta: calyx dentibus omnibus subulatis.

+ Subæquilongis, post anthesin erectis vel sursum curvatis: annuæ, erectæ, bracteis lineari- vel aceroso-subulatis demum reflexis patentibusve.

H. ACINOIDES Scheele in Linnæa, 22, p. 592. Subglabra, latifolia; calyce fauce parum pilosa, limbo vix bilabiato corolla 2–3-plo breviore. Arkansas, Texas.

H. HISPIDA Pursh. Foliosa, angustifolia; calyce bilabiato, tubo cum foliolorum linearium marginibus pilis hispidis instructo, dentibus corollam adæquantibus, inferioribus magis aristiformibus hispidis. *H. hirta* Nutt. — Trans-Mississippiana.

+ + Calycis dentibus inferioribus superiores superantibus: bracteæ sæpius erectæ pedicellis breviores.

++ Perennes basi lignescente; foliis subsessilibus, venis validis in dentes salientes excurrentibus.

H. PLICATA Torr. Bot. Mex. Bound. p. 130. — S. W. Texas.

H. DENTATA Torr. l. c. pro parte. — Arizona.

++ ++ Annuæ basi indurata quandoque perennes? foliis integerrimis parce crenulatisve, venis haud prominulis convergentibus.

H. PIPERITA Benth. Lab. p. 730? Cinereo-pubescens vel puberula; foliis ovatis obtusis basi sæpius rotundatis, floralibus supremis nunc oblongis petiolatis; verticillastris laxis pauci–plurifloris; calyce oblongo-tubuloso gibboso hirsuto, limbo satis bilabiato, labio superiore patente dentibus subulatis, inferiore dentibus magis setaceis longioribus erectis corollam subæquantibus. *H. dentata* var. *nana*, Torr. l. c. — Accords with Bentham's character of Moçino and Sesse's plant, except that the calyx is by no means twice the size of that of *H. pulegioides*. — New Mexico, Arizona, and adjacent parts of Mexico.

Var. OBLONGIFOLIA: forma strictiore altiore (pedali), foliis oblongis summis lanceolatis acutis. *H. dentata* Torr. l. c. pro parte. — New Mexico and Arizona.

H. DRUMMONDII Benth. l. c. Cinereo-puberula vel pubescens; foliis ovalibus oblongis vel (præsentim superioribus) linearibus obtusis integerrimis sessilibus vel basi angustata breviter petiolatis; verticillastris paucifloris; calyce ovato-tubuloso hispido vix bilabiato, dentibus omnibus subulato-setaceis post anthesin conniventi-erectis sursumque plus minus curvatis, inferioribus superiores dimidio superantibus corolla pl. m. brevioribus. *H. ciliata* Nutt. Pl. Gamb. p. 183. Wright's 1718, cited by Torrey under *H. plicata*, belongs here. — Nebraska and Texas to Arizona and Mexico.

A well-marked section, for the two following species, may be named: —

§ 2. STACHYHEDEOMA. Flores subsessiles spicati, corolla fauce sub labio inferiore biplicata. — Herbæ erectæ, foliis subsessilibus, summis calyceque pilis longis hirsuto-ciliatis.

H. GRAVEOLENS Chapman in herb. Caule sesquipedali e radice perenni? sæpius simplici parce hirsuto in spicam virgatam transeunte; foliis ovatis rotundisve paucidentatis (semipollicaribus), floralibus consimilibus gradatim minoribus cum bracteis oblongis flores subsessiles haud æquantibus; calycis bilabiati dentibus valde hispido-ciliatis, labii superioris lati deltoideis brevibus, inferioris angustissime subulatis tubo oblongo campanulato atque corollæ tubo subæquilongis; staminibus fertilibus labium superius vix emarginatum corollæ adæquantibus, sterilibus brevibus subulatis. Calyx inæqualiter 12 – 13-nervius, fauce pilis paucis hirsuta, corolla intus nuda. — Florida, near Apalachicola, Dr. Chapman.

H. CILIATA Benth. in DC. Caule ultrapedali e radice annua retrorsum pubescente; foliis oblongis obtusis subintegerrimis glabris basi cum floralibus angustioribus bracteisque subulatis vel setaceis pilis setisve longis albidis parce hispido-ciliatis; spica brevi densa e verticillastris 6 – 10-floris; pedicellis brevissimis complanatis; calyce fusiformi-subgibboso 15-nervio stricto basi hispido superne bilabiato, dentibus subulatis consimilibus ciliolatis post anthesin conniventibus, fauce villoso-barbata; corolla tubo vix exserto, labio superiore bilobo, fauce sub staminibus 2 brevibus inclusis pilosa; filamentis sterilibus nullis. *Keithia ciliata* Benth. Lab. — Texas, Berlandier (ex Benth.), Drummond.

CALAMINTHA (§ 3. ACANTHOMINTHA; verticillastri capituliformes, bracteis 4 majusculis rigidis foliaceis spinuloso-dentatis suffulti: antheræ subtus villoso-barbatæ) ILICIFOLIA: annua, ramosa, spithamæa, puberula; foliis caulinis floralibusque ovato-spathulatis cuneato-oblongisve (semipollicari, cum petiolo æquilongo) dentibus paucis muticis instructis; bracteis flores adæquantibus sessilibus ovatis coriaceis supra parce pilosis, venis divaricatis costaque valida in aristas rigidas productis; calyci oblongo villoso-pubescente, labio superiore tridentato quam inferiore bifido longiore et latiore, dentibus deltoideis spinuloso-apiculatis; corolla (purpurea seu alba?) calyce duplo longiori; filamentis valde inæqualibus brevibus fauci fere insertis; antheris subunilocularibus, staminum breviorum minoribus. — California, probably Lower California, Major Rich? in Herb. Torr.

SALVIA L. Dr. Torrey justly reduces *Salviastrum* of Scheele to *Salvia;* but it forms a capital section, for which Engelmann's proposed name of *Trichosphace* (Bot. Zeit. 9, p. 45), would have been most characteristic.

SALVIA (SALVIASTRUM) TEXANA Torr. Bot. Mex. Bound. p. 132. *Salviastrum Texanum* Scheele; Torr. & Gray Pacif. R. R. 2, t. 6. — Texas to New Mexico.

Var. CANESCENS: forma incana, foliis omnibus angusto-linearibus marginibus valde revolutis, floribus paucioribus. — S. W. Texas and Rio Grande on the Pecos. Wright (467), Schott.

SALVIA (SALVIASTRUM) ENGELMANNI. Vix puberula cum pilis setosis parcissimis; foliis tenuioribus, floralibus plerumque flores parcos adæquantibus; corolla (plus pollicari) tubo fauceque angustiore calyce duplo longiori; cæt. præcedentis. — W. Texas, Wright (465), Lindheimer.

SALVIA (ECHINOSPHACE) CARDUACEA Benth., includes *S. gossypina* Benth. Pl. Hartw. And the section *Echinosphace* is a good primary one when made to include *Pycnosphace* also, viz.

SALVIA (ECHINOSPHACE) COLUMBARIÆ Benth. The median tooth of the upper lip of the calyx apparently is always wanting in this species!

SALVIA (HETEROSPHACE) HENRYI. *S. Rœmerianæ* similis, gracilior, pube nec molli; foliis foliolisve minoribus vix cordatis angulato-lobatis, floralibus inferioribus sæpe conformibus, etiam summis pedicillis æquilongis; calyce hirsuto, fauce sinubusque ciliato-barbatis seu villosis; corolla (coccinea) angustiori, labiis brevioribus minus lobatis, tubo basi intus haud piloso-annulato. — New Mexico, on the Mimbres, &c., Dr. Henry, Thurber, Bigelow, and adjacent borders of Texas, Wright (not numbered).

SALVIA (CALOSPHACE) GREGGII. Frutescens, 1° – 3°-pedalis, fere glaberrima; ramis gracilibus foliosis; foliis (lin. 3 – 9 longis) oblongis obtusissimis integerrimis basi in petiolum brevem angustatis aveniis costa prominula, floralibus calyce brevioribus caducis; racemo sparsifloro; calyce vix glanduloso, labiis patentibus tubo dimidio breviore, labio superiore lobisque inferioris bipartiti ovatis mucronato-acutis; corolla (pollicari rubra) glabra, tubo valde ventricoso, fauce sub labio inferiori (superius vix glanduloso-puberulum subæquante) abrupte constricta; connectivo crure inferiori oblongo-lineari; stylo postice piloso. *S. microphylla* Torr. Mex. Bound. p. 131, non HBK. — Saltillo, Mexico, Gregg. S. Texas on the Rio Grande, Parry, Schott.

SALVIA (CALOSPHACE) PARRYI. Frutescens, humilis, ramosissima; foliis ovato-oblongis basi sæpius truncata crenatis obtusis brevipetiolatis cum ramulis tomentuloso-canescentibus, floralibus ovatis acuminatis membranaceis supra glabris persistentibus flores interrupte spicatos superantibus; calyce campanulato pilis dendriticis albis creberrime lanatis, labio superiori tridentato, inferiori bifido; corolla (parva cærulea?) pube dendritica lanulosa, labio superiore emarginato, inferiore lobis lateralibus parvis erectis, medio multo majore, iterum trilobo, lobulo medio rotundato emarginato; connectivis discretis, cruribus inferioribus semihastatis antherifero subulato æquilongis. *S. spicata?* Torr. Mex. Bound. p. 131, non R. & S. — Apache Springs, on the Rio Grande, Texas? Parry.

MONARDA L. Upon a revision of the genus, it appears evident that we have, of the section *Eumonarda*, three species with distinctly petioled leaves, viz. *M. didyma* L., *M. clinopodia* L. (excl. syn. Gronov.), and *M. fistulosa* L., the two latter pretty clearly distinct, and the last running into several remarkable varieties; also two with subsessile leaves, *M. Bradburiana* Beck, and *M. Russelliana* Nutt. Of the section *Cheilyctis*, there are *M. punctata* L., with its variety *lasiodonta* (Texas), and *M. citriodora* Cervantes, an older name than that of *M. aristata* Nutt. Of this there are two varieties, viz. var. *aristulata* (to which belongs the figure in Bot. Mag. t. 3526 and *M. penicillata* Nutt. Pl. Gamb.) and var. *tenui-aristata*.

CEDRONELLA MICRANTHA. Puberula; caule erecto; foliis membranaceis tenui-petiolatis grosse crenato-dentatis, inferioribus cordato-

ovatis obtusis, superioribus ovato-lanceolatis oblongisve, floralibus summis minutis calyce brevioribus; verticillastris sessilibus plurifloris plerisque in spicam cylindricam nudam (1 – 2-pollicarem) congestis; calyce viridulo ovato-campanulato, dentibus triangulari-subulatis tubo dimidio brevioribus; corolla (albida, vix lin. 2 longa) staminibusque parum exsertis. — S. W. Texas near the borders of New Mexico (station not recorded, Wright, without number). A close congener of *C. Mexicana* Benth., to which belongs (as a var. *cana*) *C. cana* Hook.; and *C. pallida* var. Torr. Mex. Bound. is a form with smaller and shorter corollas.

SCUTELLARIA L. Although it may be inexpedient to make of this genus a distinct tribe, as proposed by Visiani and adopted by Reichenbach, yet, now strengthened by the genus *Salizaria* Torr. (illustrated in the Botany of the Mexican Boundary), with similar embryo, &c., I should arrange for the two a subtribe (*Scutellarineæ*) of the *Stachydeæ*, — to which *Perilomia* (figured with a straight embryo) does not belong. The winged nutlets of *Perilomia*, however, are curiously imitated in one or two species of *Scutellaria*, only obscurely so in *S. parvula*, as has been noted by Dr. Torrey in the work above mentioned, but strikingly in *S. nervosa* Pursh, and in a Japanese species not otherwise very similar, viz. *S. hederacea* of Kunth and Bouché.

Dr. Torrey's reference of *S. Drummondii* to his *S. resinosa* is not borne out. The gradual transition alluded to is through a species quite distinct from either, and having neither the annual root of the former nor the filiform subterranean stolons bearing moniliform or concatenated tubers which the latter exhibits along with its near allies, *S. tuberosa*, *angustifolia*, *antirrhinoides*, and *parvula*. The nutlets of *S. resinosa*, and especially those of *S. Drummondii*,* are muricate, those of the species now distinguished are only minutely granulate and very much smaller. Its diagnosis is as follows: —

SCUTELLARIA WRIGHTII. Nec stolonosa nec tuberosa, e radice perenni lignosa multicaulis (semi – subpedalis); pube minuta; foliis ovatis et spathulato-oblongis integerrimis subsessilibus; corolla villoso-pubescente (violacea, lin. 6 – 7 longa) sursum valde ampliata, labiis æquilongis; nuculis minoribus minute granulatis. — E. Texas, Wright (no. 477, 478, 1539), Lindheimer. S. W. Arkansas, Gordon.

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* The original character of *S. Drummondii* assigns to it *crenate* leaves, of which there is, however, rarely a trace. Probably *S. cardiophylla* was confounded with it.

PHYSOSTEGIA INTERMEDIA. Caule gracili; foliis remotis lineari-lanceolatis repando-denticulatis; spicis filiformibus sæpius remotifloris; calyce brevi lato-campanulato, dentibus triangularibus acutis tubo æquilongis; corolla (vix semipollicari) fauce valde ampliata. *Dracocephalum intermedium* Nutt. Fl. Arkans. — W. Kentucky and Arkansas to Louisiana and Texas. Variable as *P. Virginiana* is, it does not include this, I think.

PHYSOSTEGIA PARVIFLORA Nutt. ex Benth. in DC. *P. imbricata* Benth. in DC., non Hook.! This, again, is a pretty well marked transmontane species, which must bear the name imposed by Nuttall: it is very different from Hooker's *P. imbricata*, which is one of the larger forms of *P. Virginiana*.

MACBRIDEA Ell. The calyx is pentamerous, but the two sepals which ordinarily compose the lower lip of the calyx are united (in *M. pulchra* Ell. almost wholly, in *M. alba* of Chapman usually but partially) with the lateral sepals, which, moreover, are free from the posterior sepal down to the throat. The anthers are pilose on the inner side, as is not uncommon in Labiatæ, and by no means, so far as I have seen, *inside*, as the phrase "intus filamentis pollini commixtis pilosæ" would imply.

STACHYS BIGELOVII. *S. coccineæ* admodum affinis, undique cinereo-puberula; foliis caulinis deltoideo-lanceolatis subcordatisque grosse crenato-dentatis (pollicaribus, cum petiolo gracili), floralibus sessilibus lanceolatis floribus sessilibus plerumque brevioribus; spica interrupta angusta; calycis dentibus subulatis tubo campanulato subdimidio brevioribus; corolla (rubra? tantum semipollicari,) tubo gracili calyce subduplo longiori, labio superiori quam inferius breviori. — W. Texas, in the crevices of rocks on the Limpio, Wright (no. 1535), Bigelow, ex Torr. Bot. Mex. Bound. p. 134, where it is doubtfully referred to *S. coccinea.* Color of corolla not recorded, seemingly not scarlet.

TRICHOSTEMA ARIZONICUM. Puberulum, multicaule e radice vel caudice ligneo perenni; ramis simpliciusculis (semi – sesquipedalibus); foliis ovalibus ovatisque breviter petiolatis, floralibus parvis pedunculis racemosis gracilibus cymoso 3 – 5-floris 2 – 3-plo brevioribus; calyce campanulato subæqualiter 5-fido æquali, lobis ovato-lanceolatis corollæ tubum adæquantibus; lobis corollæ spathulato-oblongis declinatis. (Pedunculi circa pollicares: bractæ minutæ: filamenta subpollicaria.) *T. dichotomun* Torr. Bot. Mex. Bound. l. c., non L. — S. borders of Arizona, on the slopes of the Chiricahui Mountains, Wright, no. 1541.

TEUCRIUM LACINIATUM Torr., referred of late by Dr. Torrey to *T. Cubense* L., which is also from Texas, appears to be quite clearly distinguished, by a lignescent perennial root, finely divided leaves which are usually somewhat scabrous-pubescent, larger corolla, and minutely reticulate (rather than punctate) nutlets destitute of longitudinal thickened ribs.

2. *Determination of a Collection of Plants made in Oregon by* ELIHU HALL *during the summer* of 1871, *with Characters of some New Species and various Notes.*

1. CLEMATIS LIGUSTICIFOLIA Nutt. in Torr. & Gray, Fl. 1, p. 9.

0. THALICTRUM OCCIDENTALE, n. sp. *T. dioico* simile: stigmate longiori; carpellis elongatis (maturis ad semipollicarem usque) fusiformibus parum inæquilateris subangulatis costis acutissimis 8–10 percursis acuminatis, stipite brevissimo seu vix ullo. — I have a fruiting specimen of this from the Kew distribution of the collections of the British Oregon Boundary Commission, ticketed Vancouver's Island, Dr. Lyall and C. B. Wood; and a memorandum notes that Dr. Engelmann's herbarium contains a specimen of the same, collected in Montana by Professor Swallow. In the present collection made by Mr. Hall two or three fruiting specimens also occur. There are from 5 to 10 or 12 carpels to a flower, of which a few only seem to mature. The contrast between the short ovary and the long fruit is remarkable. To this may belong a specimen of Nuttall's collection, named *T. heterophyllum*, in flower only, and a similar one in Mr. Spalding's Clearwater collection. But materials are wanting for the identification.

2. ANEMONE DELTOIDEA Hook. Fl. Bor.-Am. t. 3. In fruit.

3. TRAUTVETTERIA PALMATA Fisch. & Meyer.; forma OCCIDENTALIS, *T. grandis* Nutt.

4. RANUNCULUS (BATRACHIUM) HETEROPHYLLUS Weber.; the larger specimens (4^a) nearly equalling the var. *peltatus* (*R. peltatus* Schrank): new to this country.

5. RANUNCULUS CYMBALARIA Pursh. Fl. p. 392.

0. RANUNCULUS ALISMÆFOLIUS Geyer, a large form. For this, or rather for the dwarf and slender form, my var. *alismellus*, there is apparently an earlier name, *R. Pseudo-Hirculus* Schrenk, Enum. Pl. Nov. 2, p. 65 (from Moscow Bulletin), 1842, which is not mentioned in Walpers and has been totally overlooked. Professor Godet kindly called my attention to it, and pronounced it the same as Bolander's no. 6258.

6. RANUNCULUS FLAMMULA L. Here we have for the first time in this country specimens of genuine *R. Flammula* which in size and luxuriance fully equal the largest European forms; also (6^a) very luxuriant specimens of the var. INTERMEDIUS.

7. RANUNCULUS ORTHORHYNCHUS Hook. Fl. Bor.-Am. 1, p. 21, t. 9. The figure admirably represents this species, which is as rare in collections as it is well marked in character. But the var. *alpinus* of S. Watson, in King's Exploration on the Fortieth Parallel, is manifestly a form of my *R. adoneus*, with less rounded petals. The Rev. Edward L. Greene likewise collected it on the higher mountains in Colorado. To *R. orthorhynchus*, on the other hand, clearly belongs Lyall's plant from Washington Territory, referred to by Mr. Watson as *R. fascicularis*.*

8. RANUNCULUS NELSONII Gray, which has been confounded with *R. Occidentalis* Nutt.; and (9), its more slender variety, *R. tenellus* Nutt., which would seem to be distinct in its perfectly smooth fruit and less elongated persistent style, but is connected by transitional specimens. The synonymy is given in the subjoined foot-note.†

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* *Ranunculus fascicularis,* it may be noted, is an Eastern species, a good deal confused from the first, and not extending beyond or even to the Rocky Mountains. What has been so called from California is probably *R. Californicus* Benth. Mr. Watson's plant in King's Exploration is undeterminable. And Muhlenberg himself confounded his species with early states of the hairy form (*R. hispidus* Muhl.) of that polymorphous species which we refer to *R. repens* L., the limits of which it is still a problem to define. To this belongs the *R. fascicularis* of Schlechtendal (Animad. Ranun. 2, p. 30, t. 2), described and figured from specimens sent by Muhlenberg to Willdenow, and also *R. Schlectendalii* Hook. Fl. Bor.-Am., founded on specimens gathered by Drummond on the eastern slope of the Rocky Mountains, which were truly identified with Schlechtendal's figure; yet the *R. hispidus* of the same work is only a more developed state of it. *R. fascicularis* Muhl. fortunately was *first published* by Bigelow, in the *Florula Bostoniensis* (ed. 1, 1814), on a plant so named by Muhlenberg, identical with that figured by Hooker (tab. 8), and in my Genera Illustrata (tab. 9); to this must pertain the name, whatever else Muhlenberg may have had in view notwithstanding.

† *Ranunculi Oncostyli,* nempe achenio plano-compresso pl. m. marginato stylo recurvo-uncinato persistente superato.

* *Macranthi,* petalis (5 – 12) semipollicaribus aureis; stylo subulato brevi.

R. CALIFORNICUS Benth. Pl. Hartw. p. 295. *R. dissectus* Hook. & Arn. Bot. Beech. p. 316, non Bieb. *R. delphinifolius?* Torr. & Gray, Fl. 1, p. 659, non HBK. *R. canus* Torr. Bot. Whippl. p. 6. — California, extending to Oregon.

10. Isopyrum Hallii, n. sp. Elatum; caule 1–2-pedali) superne bifoliato; foliis amplis triternatis summove biternato; foliolis obovato-cuneatis (sesqui–bipollicaribus) irregulariter trifidis apice incisis; floribus in pedunculo communi elongato nudo vel folioso-bracteato nunc bifido pluribus umbellatim dispositis; sepalis 5 obovatis stamina numerosissima haud superantibus; filamentis apice clavatis; petalis nullis;

R. occidentalis Nutt. in Torr. & Gray, Fl. 1, p. 22, excl. char. pro parte. *R. hispidus* Hook. Fl. Bor.-Am. p. 19, pro parte. — Oregon, British Columbia, Sitka. Nuttall's species was founded, as his specimens testify, upon the large-flowered and usually very shaggy-hairy plant, which is not uncommon on the Western coast, although seldom collected in fruit (I have ripe carpels only in a specimen collected by Burke); but the description of it somehow got badly mixed up with the *R. recurvatus* of Bongard, and Nuttall's own *R. tenellus*, i. e. with the following species. To this pertains all that relates to the long style, comparatively small narrow petals, &c.

Var. canus. *R. canus* Benth. Pl. Hartw. p. 294. — California, in moist valleys of the Sacramento. Evidently a more canescent form of the present species. I have not seen the fruit, nor any other specimens answering to Hartweg's no. 1626. The specimens of Bigelow's Bot., Whipple's Expedition, referred to *R. canus*, probably belong to *R. Californicus*.

* * *Micranthi*, petalis (5) haud ultra lineas 3 longis angustis luteis; stylo elongato.

+ *Occidentales;* foliis supremis vel segmentis lanceolatis integerrimis; petalis calycem excedentibus; carpellis in capitulo 10–20.

R. Nelsonii. *R. recurvatus* var. *Nelsonii* DC, Syst. 1, p. 290. *R. recurvatus* Bong. Veg. Sitcha, p. 123, non Poir. *R. occidentalis* Torr. & Gray, l. c. pro parte. — Oregon to Sitka. Forma typica; foliis latioribus; acheniis pilis parcis rigidis pl. m. conspersis nunc glabratis stylum ejusdem longitudinis maxime uncinatum gerentibus.

Var. tenellus gracilior; foliis parvulis, lobis angustioribus; stylo quam achenium læve breviore. *R. tenellus* Nutt. in Torr. & Gray, l. c. — Northern California (Bolander) to Vancouver's Island, &c. There is a *R. tenellus* of Viviani, from Egypt, perhaps of earlier date than Nuttall's, which, though overlooked by Boisser, may claim to be used. Nuttall's name is not a good one for the whole species as now regarded; and his character is somewhat misleading as to "flowers minute" (the petals are sometimes a quarter of an inch long), and very much so as to the "minute style." The style is, indeed, less prolonged than in what I take for the type of the species; and this with the smoothness of the achenium and something in the habit of the plant might forbid the union: but there are transitions between the two forms.

+ + *Orientales;* foliis amplioribus; petalis calyce brevioribus; carpellis plurimis in capitulo denso.

R. recurvatus Poir. — Canada to Florida.

carpellis 3 – 5 ovatis brevistylibus 2 – 4-ovulatis; seminibus rugulosis. — A most distinct and much the largest and handsomest species of this genus; the flowers individually about as large as those of *I. biternatum*, but 6 to 10 together in an umbelliform often once or twice bifid cyme, and with the very numerous and conspicuous filaments as white as the sepals, and resembling those of *Trautvetteria.*

11. CALTHA LEPTOSEPALA DC. In flower and fruit.

12. COPTIS ASPLENIFOLIA Salisb. In fruit.

13. AQUILEGIA FORMOSA Fischer. Whether to be regarded as a variety of *A. Canadensis* is uncertain.

14. DELPHINIUM MENZIESII DC. The seeds will clearly distinguish all forms of this from the Eastern *D. tricorne.*

15. DELPHINIUM TROLLIIFOLIUM, n. sp. Subglabrum vel tenuiter pilosulum; caule laxo (bipedali et ultra); foliis sparsis longe petiolatis, petiolis basi subdilatatis, lamina circumscriptione orbiculata profunde 5 – 7-fida, segmentis cuneatis trifidis pauci-incisisque, lobulis obtusis (mucronulo calloso quasi truncato apiculatis); racemo sparsiflora perlaxo; pedicellis adscendenti-patentibus, inferioribus præsertim elongatis; calcare sepalis petala superantibus longiore; petalis superioribus integris albis, inferioribus subquadratis emarginato-bifidis erosis vel crenato-dentatis; folliculis oblongis glabris laxe reticulatis demum recurvo-patentibus; seminibus vertice scarioso-coronatis. Leaves in the dried specimens thin, 2 or 3, or the largest 4 or 5, inches in diameter, in outline and division reminding one of *Trollius.* Lower pedicels 2 or 3, or in fruit sometimes 4, inches long. Flowers blue, except the upper petals: spur three fourths of an inch long.

16. ACTÆA SPICATA L. var. RUBRA Michx., the *A. arguta* Nutt.

17. CIMICIFUGA (PITYSOSPERMA) ELATA Nutt. in Torr. & Gray, Fl. 1, p. 36. *C. fœtida* Pursh, non L. This is exactly a *Pityrosperma* of Zuccarini, and apparently between *P. acerinum* (which only I have a specimen of) and *P. biternatum.* In the whole structure of carpels (from one to three in number) and seeds it well unites *Macrotys* with *Cimicifuga* proper.

18. BERBERIS (MAHONIA) AQUIFOLIUM Pursh, Fl. 1, p. 219, t. 4.

19. BERBERIS (MAHONIA) NERVOSA Pursh, l. c. t. 5.

20. VANCOUVERIA HEXANDRA Decaisne. *Epimedium hexandrum* Hook. Fl. Bor.-Am. t. 13. The ovules, commonly "8 – 10," are sometimes as few as three, or even two, at least in Californian specimens.

21. ACHLYS TRIPHYLLA DC.; Hook. l. c. t. 12. Specimens chiefly with mature fruit. The pericarp, when dry somewhat quasi-cælospermous, is certainly not "bivalvatim dehiscens" nor really dehiscent at all. The whole dorsal portion, of a chestnut-brown color, is almost cartilaginous; the ventral portion thin, membranaceous, and strongly concave or cupped, with a fleshy central ridge, which when soaked, and probably in the fresh state, swells up very much and fills the concavity. This pulpy portion might be likened to the thickened placenta of *Podophyllum*. The seed, however, does not rise from it, but from the base of the cell.

22. BRASENIA PELTATA Pursh. The only specimens seen from the Pacific side of the continent, except those collected in Wilkes's Exploring Expedition.

0. NUPHAR POLYSEPALUM Engelm. in Trans. Acad. St. Louis.

23. ESCHSCHOLTZIA CALIFORNICA, var. DOUGLASII Torr. & Gray: chiefly small-flowered forms.

24. DICENTRA FORMOSA DC. Apparently not distinct from the Eastern *D. eximia*.

25. NASTURTIUM CURVISILIQUA Nutt. in Torr. & Gray, l. c. Char. to be altered, and species to include at least *N. polymorphum* Nutt., a better name for it. Forms, with slender pod and sometimes slender pedicel, the style very short but distinct (25): with shorter narrow pod on short pedicel (26): with thicker pod on short pedicel, nearly or quite the same as *N. lyratum* Nutt. (27).

28. NASTURTIUM PALUSTRE DC.: the ordinary European form. — N. 4, of Lyall's collection on the 49th parallel, with pods too long for *N. palustre*, is exceeded in this respect by the plant from the same district, (wrongly) named *N. lyratum* in the 12th volume of the Pacific Railroad Explorations, which again comes near *N. montanum* Wall., a species which on the Asiatic side occurs as far north as Corea.

29. CARDAMINE CORDIFOLIA Gray Pl. Fendl. p. 8. Form with weaker stem and ampler leaves, of round-cordate or almost reniform outline, bearing therefore a closer resemblance to *C. asarifolia*, but the less dentate leaves, short style, and smaller stigma distinguish it. Watson's specimens from Utah and Nevada are intermediate between these and Fendler's original plant.

30. CARDAMINE ANGULATA Hook. Bot. Misc. 1, p. 243, t. 69.

31. CARDAMINE OLIGOSPERMA Nutt. in Torr. & Gray, l. c. Apparently a good species. Radical leaves often simple.

32. CARDAMINE HIRSUTA L.: an ordinary form; with some of a slender small-leaved variety, named by Nuttall *C. microphylla.*

33. ARABIS HIRSUTA Scop.; the western form; and A. PERFOLIATA Lam., the form which is *Turritis macrocarpa* Nutt., sparingly collected.

34. THELYPODIUM LACINIATUM Endl. (*Macropodium* Hook.) In fruit.

35. ERYSINUM ASPERUM DC., var. *E. elatum* Nutt. l. c.

36. SISYMBRIUM DEFLEXUM Harvey; Torr. Bot. Whippl. p. 10. With mature fruit.

37. LEPIDIUM MENZIESII DC.; Hook. Fl. Bor.-Am. 1, p. 68.

38. THYSANOCARPUS CURVIPES Hook. l. c. p. 69, t. 18.

39. THYSANOCARPUS PUSILLUS Hook. Ic. t. 43, which includes *T. oblongifolius* Nutt.

40. CLEOME LUTEA Hook. Fl. Bor.-Am. 1, p. 70, t. 25.

41. VIOLA BLANDA Ait.; apparently, but wholly in fruit.

42. VIOLA CANINA L., var. *V. adunca* Smith; Hook. 1, p. 79.

43. VIOLA NUTTALLII Pursh.; Hook. l. c. t. 26. Mostly in fruit.

44. VIOLA SARMENTOSA Dougl. in Hook. l. c. Small form, in fruit.

45. VIOLA GLABELLA Nutt. in Torr. & Gray, l. c. Too near *V. pubescens.*

46. VIOLA HALLII, n. sp. *Melanium*, glabra, ut videtur perennis; caulibus e surculo gracili adscendentibus spithamæis a basi foliatis; foliis trisectis, segmentis in petiolum longum rhachinque decurrentibus cuneatis trifidis (lateralibus quandoque lanceolatis subintegris), lobis lanceolatis sæpius integerrimis; stipulis foliaceis lanceolatis oblongisve sublaciniatis, uno sæpissime multo minore integerrimo; petalis 3 luteis quorum lateralibus basi tenuiter barbatis, 2 superioribus atro-violaceis; calcare brevissimo. — Most unexpected as a North American species, and a striking and handsome one, with the flower of a Pansy; the petals half an inch or more in length. Style clavate, the large almost regular stigma bearded all round. Near Salem.

47. HYPERICUM ANAGALLOIDES Cham. & Schlecht. in Linnæa, 3, p. 127.

48. HYPERICUM SCOULERI, Hook. Fl. Bor.-Am. 1, p. 111.

49. ELATINE AMERICANA Arn. *Crypta minima* Nutt.

50. SILENE DRUMMONDII, Hook. Fl. Bor.-Am. — Two or three

specimens were gathered, in cemetery grounds near Salem, of what seems to be *S. Bolanderi* Gray, Proceed. Acad. 7, p. 330.

51. SILENE MENZIESII Hook. l. c. p. 99, t. 30.

51ª. ARENARIA (MŒHRINGIA) MACROPHYLLA Hook. l. c. t. 37.

52. ARENARIA TENELLA Nutt. in Torr. & Gray, Fl. p. 179.

53. STELLARIA MEDIA L. Apparently indigenous.

54. STELLARIA CRISPA Cham. & Schlecht. in Linnæa, 1, p. 51.

55. STELLARIA BOREALIS Bigelow, var. COROLLINA Fenzl in Ledeb. Fl. Ross. *S. alpestris* Fries. The same collected at Lake Superior by Dr. Robbins.

56. STELLARIA NITENS Nutt. in Torr. & Gray, Fl. l. c.

57. CERASTIUM VULGATUM L. Apparently an indigenous form.

58. SAGINA LINNÆI Presl. A little *S. procumbens* L. also collected.

59. SPERGULARIA MEDIA Presl. the form called *Lepigonum leiospermum* by Kindberg; and 60, S. RUBRA Presl.

61. MOLLUGO VERTICILLATA L.

62. CLAYTONIA SIBIRICA L. *C. alsinoides* Sims. A larger and a smaller form.

63. CLAYTONIA PERFOLIATA Donn. 64. A depauperate variety, the *C. parviflora* Dougl.

65. CLAYTONIA CHAMISSONIS Eschsch. *C. flagellaris* Bongard and *C. aquatica* Nutt. 66. Var. TENERRIMA, an exceedingly depauperate and slender form of this species.

67. CLAYTONIA LINEARIS Hook. Fl. Bor.-Am. t. 71. 68. A form larger in all its parts, the seeds a full line in diameter.

69. CLAYTONIA PARVIFOLIA Moçino. *C. filicaulis* Hook. l. c. t. 72. — *C. diffusa* Nutt. in Torr. & Gray Fl. is an interesting species of the region yet to be rediscovered.

70. SPRAGUEA UMBELLATA Torr. Pl. Fremont, t. 1. New to Oregon.

71. SIDALCEA MALVÆFLORA Gray, Pl. Fendl., & Pl. Wright: two or three forms.

72. GERANIUM CAROLINIANUM L. 73. G. INCISUM Nutt. in Torr. & Gray, l. c. 73ª. ERODIUM CICUTARIUM L'Her.

74. OXALIS OREGANA Nutt. in Torr. & Gray, l. c. 75. O. CORNICULATA L.

76. PACHYSTIMA MYRSINITES Raf. *Myginda myrtifolia* and later *Oreophila myrtifolia* Nutt.

77. Rhamnus Purshianus DC.; Hook. l. c. t. 43.

78. Ceanothus velutinus Dougl. in Hook. l. c. t. 45. In fruit.

79. Ceanothus Oreganus Nutt. in Torr. & Gray, Fl. 1, p. 265.

80. Acer macrophyllum Pursh, and 81. A. circinatum Pursh; both in fruit.

82. Rhus diversiloba Torr. & Gray, l. c. *R. lobata* Hook. l. c. t. 46. In fruit and flower.

83. Thermopsis fabacea R. Br., var. montana Gray. *T. montana* Nutt. in Torr. & Gray.

84. Lupinus bicolor Lindl., which is likewise *L. micranthus* Dougl.

85. Lupinus polyphyllus Lindl. Bot. Reg. t. 1097.

86. Lupinus latifolius Agardh, Syn. Lup.; a variety, or some species near it.

87. Lupinus leucophyllus Lindl. Bot. Reg. t. 1124.

88. Lupinus ornatus Dougl., and 89, L. foliosus Nutt., in small quantity.

90. Lupinus laxifolius Dougl., by the calyx; but a remarkable, rather densely flowered variety.

91. Lupinus parviflorus Nutt. in Torr. & Gray, Fl. 1, p. 375.

92. Lupinus minimus Dougl. in Hook. Fl. Bor.-Am. 1, p. 163.

93. Lupinus holosericeus Nutt. in Torr. & Gray, Fl. 1, p. 380. In fruit.

94. Trifolium eriocephalum Nutt. in Torr. & Gray, Fl. 1, p. 313.

95. Trifolium Macræi Hook. & Arn. Bot. Beech. *T. albopurpureum* Torr. & Gray, l. c.

96. Trifolium ciliolatum Benth. Pl. Hartw. Not before found north of California. The rhachis is often prolonged into a filiform tip, projecting much beyond the head.

97. Trifolium gracilentum Torr. & Gray, l. c.: a slender variety.

98. Trifolium cyathiferum Lindl.; Hook. Fl. Bor.-Am. t. 50.

99. Trifolium microdon Hook. & Arn. Bot. Beech. t. 79.

100. Trifolium microcephalum Pursh; Torr. & Gray, l. c.

101. Trifolium pauciflorum Nutt. in Torr. & Gray, l. c.

102. Trifolium fimbriatum Lindl. Bot. Reg. t. 1070; small forms, with broad leaflets. 103. Var. angustifolium. *T. tridentatum* Lindl. Bot. Reg.

104. GLYCYRRHIZA LEPIDOTA Nutt.; Bot. Mag. t. 2050. Chiefly in fruit.

105. PSORALEA LANCEOLATA Pursh. Fl. 2, p. 475; Hook. Fl. Bor.-Am. p. 135, t. 51.

106. PSORALEA PHYSODES Dougl. in Hook. l. c.*

107. HOSACKIA DECUMBENS Benth.; Torr. & Gray, l. c. p. 324.

108. HOSACKIA CRASSIFOLIA Benth.; Gray, Rev. p. 350. *H. stolonifera* Lindl. Bot. Reg. t. 1977.

109. HOSACKIA BICOLOR Dougl.; Lindl. Bot. Reg. t. 1257.

110. HOSACKIA GRACILIS Benth.; a depauperate form.

111. HOSACKIA PARVIFLORA Benth.; Gray, Rev. p. 351.

112. HOSACKIA (MICROLOTUS) PURSHIANA Benth., a pubescent form: also, *113*, an almost glabrous variety, *H. elata*, var. *glabra* Nutt. in Torr. & Gray, l. c.

114. VICIA GIGANTEA Hook. Fl. Bor.-Am. 1, p. 157.

115. VICIA OREGANA Nutt. in Torr. & Gray, l. c. A form of *V. Americana*, apparently; very variable in the foliage; passing into 116, V. TRUNCATA Nutt. and V. SPARSIFLORA Nutt. l. c., the latter with all the leaves linear and narrow.

117. LATHYRUS TORREYI Gray, Proc. Am. Acad. 7, p. 337.

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* I here append the characters of an interesting addition to a chiefly Eastern North American genus, viz.: —

PETALOSTEMON SEARLSIÆ, n. sp.: perennis? præter spicam glaberrimus; foliis 5-7-foliolatis cum caule ramisve simplicibus grosse glandulosis; foliolis oblongo-linearibus obtusis vel retusis crassiusculis; spica longiuscule pedunculata cylindrica compacta; bracteis ovatis membranaceis pauci-glandulosis in acumen caudiforme calycem adæquantum productis sericeo-ciliatis deciduis; calycis dentibus attenuato-subulatis mollissime villosis tubo minus pubescente æquilongis; petalis roseo-purpureis præter vexillum deltoideo-cordatum angusto-oblongis. — The only other species found west of the Mississippi Valley is the *P. exile* of Wright's collection, from Arizona. This is from a similar region farther north; viz., from the Pahranagat Mountains in southeastern Nevada (about 400 miles southwest of Salt Lake), where it was discovered by Miss Searls. It was one of an extremely interesting collection made by this young lady in the vicinity of the Pahranagat mines (which she visited in company with her father), and entrusted to me by Professor Marcy of Evanston, Ill. A lady who braves the hardships of a journey to such a remote and inhospitable district, and has the sense and spirit to make a collection of plants in a place far out of the track of any botanist, well deserves to have her name perpetuated in the annals of botany. I give it accordingly with much satisfaction to one of the two entirely new plants of the collection.

For others, see succeeding notes, e. g. *Œnothera*, *Chænactis*, *Pentstemon*, &c.

118. Lathyrus venosus var? Torr. & Gray, l. c. *L. pubescens* Nutt. l. c.; but mainly glabrous. Fruiting specimens.

119. Lathyrus polyphyllus Nutt. in Torr. & Gray, l. c.

120. Prunus (Cerasus) mollis, Dougl. in Hook. l. c. This is probably *P. erecta* Presl, Epimelia, p. 194.

121. Prunus Virginiana L. var., the *Cerasus demissa* Nutt. in Torr. & Gray, Fl. 1, p. 411, which is commonly thought distinct by those who have seen it living.

122. Nuttallia cerasiformis Torr. & Gray, Fl. 1, p. 412. In fruit.

123. Spiræa opulifolia L.; a Western, but nearly glabrous form.

124. Spiræa betulæfolia Pallas; a small-leaved form. Also, 125, var. rosea, with rose-red corolla, found likewise in California.

126. Spiræa Douglasii Hook. l. c.; Bot. Mag. t. 5151.

127. Spiræa Menziesii Hook. l. c.

128. Spiræa ariæfolia Smith; Hook. l. c.

129. Geum macrophyllum Willd.; Torr. & Gray, Fl. 1, p. 421. Referred to *G. Japonicum* by Scheutz in his recent monograph; but the identification is not wholly satisfactory. See Amer. Jour. Science, April, 1872, p. 306.

130. Alchemilla occidentalis Nutt. in Torr. & Gray, Fl. 1, p. 421.

131. Poterium annuum Nutt. in Hook. l. c. *Sanguisorba annua* Nutt. in Torr. & Gray, l. c.

132. Poterium officinale, i. e. *Sanguisorba officinalis L.* Already found both north and south of Oregon.

133. Horkelia congesta Hook. Bot. Mag. t. 2880.

134. Potentilla glandulosa Lindl. Bot. Reg. t. 1583.

135. Potentilla diversifolia Lehm. in Hook. l. c.

136. Potentilla gracilis Dougl., Hook. Bot. Mag. t. 2984.

137. Fragaria vesca L., the var. γ. Torr. & Gray, Fl. 1, p. 448.

138. Rubus Nutkanus Moçino. One or two specimens displayed rose-red flowers, like those of its Eastern analogue, *R. odoratus*, but the tinge was slight when fresh, according to Mr. Hall.

139. Rubus spectabilis Pursh, Fl. 1, t. 16; the Salmon-Berry.

140. Rubus pedatus Smith Ic. Ined. t. 63. *Comaropsis pedata* DC. Prodr.

141. Rubus leucodermis Dougl.; Torr. & Gray, l. c. In fruit.

142. Rubus macropetalus Dougl. in Hook. l. c. t. 59.

143. Rosa gymnocarpa Nutt. in Torr. & Gray, l. c. p. 461.

144. Rosa blanda Ait.? Chiefly, at least the fruiting specimens, of the form (if such it be) answering to *R. Woodsii* Lindl. Ros. & Bot. Reg. t. 976. Fruit subdepressed-globose, with no neck at all; until full-grown with the calyx-lobes spreading, then apparently ascending or erect. *R. fraxinifolia* of Watson in King's Exploration is the same with larger fruit. — A small quantity, insufficient for distribution, was collected, of a common Nevadan and Californian Rose, Mr. Watson's *R. blanda.* This has smaller flowers, stipular prickles when present inclined to curve, the calyx-tube with a contracted neck, and an ovoid-globular fruit, about 5 lines long when full grown, the persistent calyx-lobes tardily ascending or at length conniving. I do not know this in North-eastern America, to which *R. blanda* proper belongs. I take it to be Chamisso and Schlechtendal's *R. Californica.*

145. Rosa pisocarpa, n. sp. Gracilis, aut inermis aut aculeis substipularibus acicularibus tenuibus rectis nunc paucisque minimis petiolaribus munitis; corymbo pauci-plurifloro bracteoso; calycis lobis (extus glandulosis intus cano-tomentosis) e basi ovata in acumen sæpius gracile sursumque lanceolato-dilatatum productis, tubo glabro primum urceolato, fructifero fere globoso (pisi magnitudine) basibus tantum loborum persistentibus arcte reflexis coronato; pedunculis fructiferis nutantibus; — cæt. præcedentis vel *R. blandæ* forma minoris. Petala læte rosea, obcordata, lin. 6 – 8 longa. Foliola semipollicaria ad pollicaria.

146. Rosa Kamtschatica Vent. Cels. t. 67. In fruit only; the strong shoots densely setose, and with immense dilated aculei. One or two smooth specimens also collected. An intermediate form is in Dr. Lyall's collection, from Vancouver's Island. The *R. cinnamonea* in Pl. Hartweg, to which Ventenat's plant is referred as a synonyme, is wholly different, and apparently *R. Californica,* Cham. & Schlecht.

147. Pyrus rivularis Dougl.; Hook. Fl. Bor.-Am. t. 68.

148. Pyrus (Sorbus) sambucifolia Cham. & Schlecht. In fruit.

149. Amelanchier Canadensis var. alnifolia Torr. & Gray, Fl. 1, p. 473. In fruit.

150. Saxifraga integrifolia Hook. Fl. Bor.-Am. 1, p. 249, t. 86.

151. Saxifraga Virginiensis Michx.; a very tall form.

152. SAXIFRAGA HETERANTHA Hook. l. c. t. 78. A very distinct species, although considered to be a variety of the next in Torrey and Gray's Flora.

153. SAXIFRAGA PUNCTATA L. *S. æstivalis* Fischer; Torr. & Gray, Fl. &c.

154. SAXIFRAGA TOLMÆI Torr. & Gray, Fl. 1, p. 567. A few specimens.

155. SAXIFRAGA CÆSPITOSA L.; Hook. Fl. Bor.-Am. l. c.

156. SAXIFRAGA ELEGANS Nutt. in Torr. & Gray, Fl. 1, p. 573. Beautiful and abundant specimens, some of them many times larger than Nuttall's. Judging from these specimens the species may well deserve the name.

157. BOYKINIA OCCIDENTALIS Torr. & Gray, Fl. 1, p. 577 & p. 698. 158. Var. ELATA. *Saxifraga elata* Nutt. l. c.

159. HEUCHERA MICRANTHA Dougl. in Bot. Reg. t. 1302; Hook. Fl. Bor.-Am. l. c.

160. HEUCHERA CYLINDRICA Dougl. in Hook. l. c.; Bot. Reg. t. 1924.

161. TOLMIEA MENZIESII Torr. & Gray, Fl. 1, p. 582. An interesting plant, rarely collected.

162. TELLIMA GRANDIFLORA Dougl. in Bot. Reg. t. 1178.

163. MITELLA CAULESCENS Nutt. in Torr. & Gray, Fl. 1, p. 586.

164. MITELLA TRIFIDA Graham; Hook. Fl. Bor.-Am. t. 82.

165. TIARELLA TRIFOLIATA L.; Pursh, Fl. 1, p. 313.

166. TIARELLA UNIFOLIATA Hook. Fl. Bor.-Am. 1, p. 238, t. 81.

167. PHILADELPHUS LEWISII Pursh, Fl. 1, p. 329.

168. RIBES DIVARICATUM Dougl.; Lindl. Bot. Reg. t. 1359. In fruit.

169. RIBES SETOSUM Dougl. in Hook. l. c.; a variety of *R. lacustre* Poir. In fruit.

170. RIBES SANGUINEUM Pursh, Fl. 1, p. 164.

171. RIBES BRACTEOSUM Dougl. in Hook. l. c.

172. SEDUM SPATHULIFOLIUM Hook. Fl. Bor.-Am. 1, p. 227.

173. TILLÆA ANGUSTIFOLIA Nutt. in Torr. & Gray, Fl. 1, p. 558.

174. MYRIOPHYLLUM HIPPUROIDES Nutt. in Torr. & Gray, Fl. 1, p. 530.

175. EPILOBIUM ANGUSTIFOLIUM L.

176–8. EPILOBIUM TETRAGONUM L., or allied species, in several forms.

179. EPILOBIUM ALPINUM L., or nearly allied to it. 180. A form near it in fruit.

181. EPILOBIUM MINUTUM Lindl. in Hook. l. c.

182. EPILOBIUM PANICULATUM Nutt. in Torr. & Gray, Fl. 1, p. 490.

183. GAYOPHYTUM NUTTALLII Torr. & Gray, Fl. 1, p. 514, with rather slender pedicels.

184. ŒNOTHERA ALBICAULIS Nutt. in Fraser, Cat. & Gen.*

185. ŒNOTHERA (BOISDUVALIA) DENSIFLORA Lindl. Bot. Reg. t. 1593. 186. A more villous form. 187. A narrow-leaved and strict variety. *Œ. imbricata* Nutt. in herb. 188. A less pubescent, narrow-leaved, slender variety. *Œ. salicina* Nutt. in Torr. & Gray, l. c. 189. Var. TENELLA: a depauperate and very small-flowered canescently villous form.

190. ŒNOTHERA (BOISDUVALIA) GLABELLA Nutt. in Torr. & Gray, l. c.

191. ŒNOTHERA LINDLEYI Dougl.; Bot. Mag. t. 2832.

192. ŒNOTHERA, one of the Oregon Godetias which have been referred to *Œ. tenella.*

193. ŒNOTHERA PURPUREA Curtis Bot. Mag. t. 352, a small-flowered form, which includes *Œ. lepida* and *Œ. quinquevulnera?* 194. A depauperate small-flowered variety of the same.

195. GAURA PARVIFLORA Dougl. in Hook. Fl. Bor.-Am. 1, p. 208.

196. LUDWIGIA PALUSTRIS Ell. *Isnardia palustris L.*

197. CIRCÆA PACIFICA Ascherson & Magnus in Bot. Zeit. 1871, p. 392. Same as Bolander's and Lyall's plants from which the species is described, and as *C. Lutetiana* var. *occidentalis* of Nuttall in herb.; but allied to *C. alpina.*

198. ECHINOCYSTIS FABACEA Decaisne. *Sicyos Oreganus* Torr. & Gray, Fl. 1, p. 542. Very fine specimens of this, the Oregon form of *Megarrhiza* Torr., which may fairly claim generic rank.

199. MENTZELIA LÆVICAULIS Torr. & Gray, Fl. 1, p. 535. *Bartonia lævicaulis* Dougl.; Hook. l. c. t. 69.

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[*] ŒNOTHERA BRACHYCARPA Gray, Pl. Wright, 1, p. 70, and 2, p. 57, was among the interesting plants collected by Miss Searls in the Pahranagat Mountains, Nevada. It is the *Œ. marginata* var. *purpurea* of S. Watson in King's Expedition, but is very different from *Œ. cæspitosa* Nutt. (the oldest name of the species which is to comprise *Œ. marginata, montana,* and *eximia,* doubtless well combined by Mr. Watson), as the fruit demonstrates. The corolla, instead of pale yellow turning rose-color, is now known to be white with a purple tinge from the first.

200. Eryngium petiolatum Hook., var. juncifolium: gracile, subsesquipedale; petiolis longissimis nodoso-articulatis, radicalibus (6 – 10 poll. longis) nunc aphyllis nunc lamina parva (pollicari) lanceolata superatis; capitulis parvulis. — Hooker's species must include his *E. articulatum* in Pl. Geyer., as well as the present slender form of it, the petioles of which imitate those of one of the nodose *Junci*. Nuttall collected the same plant on the Willamette.

201. Sanicula Menziesii Hook. & Arn.; Hook. Fl. Bor.-Am. 1, p. 258, t. 90.

202. Sanicula bipinnatifida Dougl. in Hook. l. c. t. 92.

203. Carum Gairdneri Benth. & Hook. *Atænia* Hook. & Arn. *Edosmia* Nutt.

204. Œnanthe sarmentosa Nutt. in Torr. & Gray, Fl. 1, p. 617.

205. Crantzia lineata Nutt. Remarkably fine and large specimens, with ripe fruit.

206. Pimpinella apiodora Gray, Proc. Am. Acad. 7, p. 345: var. nudicaulis: parvula; caule scapiformi subaphyllo vix pedali. Apparently a small and high-mountain form of the Californian species; in flower only.

207. Ligusticum (Cynapium) apiifolium, Gray, l. c. p. 347.

208. Angelica genuflexa Nutt. in Torr. & Gray, Fl. 1, p. 620, ex. char. With immature fruit.

209. Ferula (Leptotænia) dissecta Gray, l. c. In fruit.

0. Peucedanum macrocarpum Nutt. in Torr. & Gray, l. c. Two or three specimens of the true plant, with ripe fruit, 8 lines long and less than 3 lines wide, including the wing, which on each side is about the width of the disk. — 210. Var.? eurycarpum: fructus lato-elliptici alis tenuibus utrinque disco latioribus. Specimens with mature fruit only, in some 8 lines long and with the wing fully 2 lines wide on each side; probably a state of this species, certainly so, if Torrey's var. *platypterum* is, but that remains very doubtful; in other specimens half an inch long, and the wing a line and a half wide: this approaches *P. millefolium* S. Watson.

211. Peucedanum nudicaule Nutt. l. c. *Smyrnium nudicaule* Pursh?

212. Peucedanum utriculatum Nutt. in Torr. & Gray, l. c.

213. Peucedanum triternatum Nutt. l. c. *Seseli triternatum* Pursh; Hook. l. c. t. 94.

214. PEUCEDANUM LEIOCARPUM Nutt. l. c. *Seseli leiocarpum* Hook. l. c. t. 93.

215. SIUM LINEARE Michx.; Gray Man. ed. 5, p. 196.

216. OSMORRHIZA NUDA Torr. Bot. Whippl. This does not seem to pass into *O. brevistylis*, with which it has been perhaps unavoidably confounded.

217. GLYCOSMA AMBIGUUM, n. sp. Distinguished from *G. Bolanderi* by greater smoothness, more acute and incised leaflets, longer pedicels, and especially by the shorter fruit (6 or at most 7 lines long), which is decidedly contracted at the commissure, and the ribs towards the base more or less setose, — characters which, with the habit, ally this plant to *Osmorrhiza* much more than to *Myrrhis*. While Bentham and Hooker referred Nuttall's *Glycosma* to *Myrrhis*, they neglected to extend the character so as to include it. It is now clear to me that the genus should be kept distinct both from *Myrrhis* and *Osmorrhiza*, although between the two. The cardinal characteristic of *Osmorrhiza* is the caudate attenuation of the base of the carpels. *Glycosma* has none of this, but the base is abrupt and obtuse. From *Myrrhis* it differs in habit, geographical distribution, absence of involucels, and strikingly in the merely costate (not enlarged and wing-like) juga. As to the breadth of the commissure or contraction of the sides of the fruit, while the original species is much like *Myrrhis* in this respect, the present one is more like *Osmorrhiza*.*

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* GLYCOSMA Nutt. in Torr. & Gray, Fl. 1, p. 639. *Myrrhis & Glycosma* Gray, Proceed. Acad. 7, p. 346.

* Fructus lævis, basi obtusissimus, commissura lata.

G. OCCIDENTALE, Nutt. l. c. Pruinoso-puberula; foliolis oblongo-lanceolatis oblongisve serratis raro incisis; umbellæ fructiferæ radiis suberectis, pedicellis flores sterilia pl. m. superantibus; fructus jugis acutis. *Myrrhis occidentalis* Gray Proc. Acad. l. c.

G. BOLANDERI, subpubescens; foliolis ovatis magis incisis; umbellæ fructiferæ radiis patentibus, pedicellis floribus sterilibus brevioribus; fructus jugis obtusis. *Myrrhis Bolanderi*, Gray, l. c.

* * Fructus breviusculus, basi acutiusculus ad commissuram parum constrictus, costis inferne pl. m. setulosis (nunc denudatis).

G. AMBIGUUM, n. sp. Elatum, glabrum; petiolis costisque subtus pilosiusculis; foliolis ovato-oblongis acutis dentato-incisis sæpiusque 2-3-fidis tenuiter membranaceis; umbellæ fructiferæ radiis patentibus; pedicellis flores sterilia æquantibus; fructu (6-7 lin. longi) lineari-oblongo utrinque acutiusculo. — Foot of Cascade Mountains, Oregon.

I may here append the characters of a new species of *Musenium*, viz.: —

218. ECHINOPANAX HORRIDA Decaisne. (*Panax horridus* Smith.) *Fatsia* § *Tetrapanax* (Koch) Benth. & Hook. f. In fruit.

219. CORNUS NUTTALLII Audubon, Birds of N. Amer. t. 367.

220. CORNUS SUECICA L. (with a little *C. Canadensis*).

221. CORNUS SERICEA var.? OCCIDENTALIS Torr. & Gray, Fl. 1, p. 652. Probably *C. Drummondii* C. A. Meyer, and distinct from any Eastern species.

222. LINNÆA BOREALIS Gronovius.

223. SYMPHORICARPUS RACEMOSUS Michx., var. PAUCIFLORUS Robbins in Gray Man. ed. 5, p. 203.

224. LONICERA CILIOSA Poir.; Torr. & Gray, Fl. 2, p. 5. *Caprifolium ciliosum* Pursh.

225. LONICERA HISPIDULA Dougl.; Torr. & Gray, l. c. *Caprifolium hispidulum* Lindl. Bot. Reg. t. 1761.

226. LONICERA CALIFORNICA Torr. & Gray, l. c.; a variety with glabrous peduncle, ovaries, &c.

227. LONICERA (XYLOSTEON) INVOLUCRATA Banks; Lindl. Bot. Reg. t. 1179.

228. VIBURNUM ELLIPTICUM Hook. Fl. Bor.-Am. 1, p. 280.

229. SAMBUCUS PUBENS Michx., var. In fruit.

230. SAMBUCUS GLAUCA Nutt. in Torr. & Gray, Fl. 2, p. 13.

231. GALIUM APARINE L., var. MINOR, and 232. G. TRIFIDUM L.

233. GALIUM TRIFLORUM Michx., var. Peculiar Western forms.

MUSENIUM GREENEI, n. sp. Acaule; foliis omnibus e caudice apice squamosofere simpliciter pinnatis angustis; foliolis 7–9 secus rhachin apice tantum marginatam sessilibus ambitu subovatis pinnatifido-5–7-lobatis pauci-dentatisque, dentibus lobisque argutis; scapis ultra spithamæis omnino nudis simplicissimus; umbella brevi-radiata; involucellis e bracteis 3–4 subulatis flores "flavos" subsessiles subæquantibus; fructu oblongo obtusissimo truncato lævi calycis dentibus ovato-subulatis submarcescentibus coronato, jugis prominulis angustissimis, vittis interjugalibus 1–2 magnis, sub jugis ipsis solitariis parvis. — Colorado, in the lower mountains above Golden City, in shady places, (June 24, with well-formed fruit), Rev. Edward L. Greene. The discoverer of this plant has botanized so earnestly in this region, and has sent me so many beautiful and interesting specimens, that I hasten to pay a well-deserved acknowledgment by affixing his name to the first actually new species which I have received from him. The root and fruits are strong-scented, in the manner of the genus, and the whole plant, as usual, is glabrous. The fruit (about 2 lines long) is peculiar in not being at all contracted at the apex, and its ribs are very thin. The absence of all roughness does not prevent me from referring the plant to *Musenium*, for the true *M. divaricatum* (of which there is an excellent figure by Sprague in the 12th volume of the Pacific Railroad Surveys, Stevens's Expedition) is also quite smooth.

234. GALIUM BOREALE L.: the form with a glabrous ovary.

235. GALIUM LITTELLII OAKES. Caule lævi subsimplici vix ultrapedali erecto; foliis quaternis ovali-ovatis quandoque ovato-lanceolatis acutiusculis trinervibus ciliatis cæterum sæpius glabris; cymulis plurifloris longius pedunculatis paniculatis; pedicellis omnibus longiusculis, fructiferis divaricatis; corollæ flavidæ glabræ segmentis ovatis obtusis; fructu setis uncinatis crebris setoso. *G. circæzans* var. *montanum* Torr. & Gray, Fl. 2, p. 24. Appears identical with the White Mountain plant, of which few and imperfect specimens were extant, and it would seem truly distinct from *G. circæzans*.

236. PLECTRITIS CONGESTA DC. Prodr. 4, p. 461.

237. ADENOCAULON BICOLOR Hook. Bot. Misc. 1, p. 19, t. 15.

238. MACHÆRANTHERA CANESCENS Gray, Pl. Wright; a narrow-leaved variety, which includes *Dieteria divaricata* Nutt.

239. SERICOCARPUS RIGIDUS Lindl., in Hook. Fl. Bor.-Am. 2, p. 14.

240. SERICOCARPUS OREGONENSIS Nutt.; Torr. & Gray, Fl. 2, p. 103. Probably only a larger form of the preceding.

241. ASTER (CALLIASTRUM) RADULINUS, n. sp. This plant, which grows also in California (and is probably *A. Radula* Less. in Linnæa, which Nees has referred to his *A. Chilensis* = *A. Durandi* Nutt.), is difficult to distinguish from *A. conspicuus* Lindl., except by the much diminished size of all the parts and the turbinate involucre. Mr. Hall's specimens vary from 5 to 15 inches in height, and the involucre is barely 4 lines long. The rays appear to be white. On the other hand it approaches *A. montanus* of Richardson; but the involucre is turbinate, its scales more imbricate and appressed, the leaves rougher, &c.

242. ASTER (ORTHOMERIS) ENGELMANNII Gray, var. LEDOPHYLLA. Minor, pedalis; foliis obtusis subtus pube molli derasibili cinereis vix sesquipollicaribus; involucri squamis sensim acuminatis. A remarkable variety, which one of the plants of Lyall's collection serves somewhat to connect with the Rocky Mountain form; but the small size of the leaves (which are very numerous) and the slender-tipped purple involucral scales are peculiar. The specimens are scanty. They were collected high up in Cascade Mountains.

243. ASTER HALLII, n. sp. This is apparently a distinct and unpublished species, of the *Dumosi* group, but requires study.

244. ASTER DOUGLASII Lindl.: in various forms. 245. Perhaps a variety of the last, but with lax and more foliaceous involucral scales.

246. ASTER (ORITROPHIUM) SAYI Nutt. herb. Near *A. perigrinus*, *Sibiricus*, and *salsuginosus*.

247. ASTER SALSUGINOSUS Richardson. An alpine form, scantily collected with the next.

248. ASTER (XYLORHIZA) ALPIGENUS. *Aplopappus? alpigenus* Torr. & Gray, Fl. 2, p. 241. It appears from these copious and beautiful specimens that the rays are violet-colored. The species is nearly allied to *A. Andersonii* Gray; and, with *A. pulchellus* of Eaton (just published in the Botany of King's Exploration), we have now three subscapigerous species of this group.

249. ERIGERON BELLIDIASTRUM Nutt. l. c. Not before reported from Oregon.

250. ERIGERON GLAUCUM Ker. Bot. Reg. t. 10; Torr. & Gray, l. c.

251. ERIGERON SPECIOSUM DC. *Stenactis speciosa* Lindl. Bot. Reg. t. 1577.

252. ERIGERON STRIGOSUM Muhl.; Torr. & Gray, l. c.

253. ERIGERON FILIFOLIUM Nutt.; Torr. & Gray, l. c.

254. ERIGERON DECUMBENS Nutt.; Torr. & Gray, l. c. A slender form.

255. LINOSYRIS VISCIDIFLORA Hook.; Torr. & Gray, Fl. 2, p. 234.

256. APLOPAPPUS LANCEOLATUS Torr. & Gray, l. c. (at least it is *Homopappus multiflorus* Nutt.), var. STRICTA. Resembles *Pyrocoma racemosa* and *paniculata*, Torr. & Gray; but achenia densely silky-canescent and shorter. Stem slender, strict, leafy, bearing 3 to 10 rather distinct spicate heads.

257. APLOPAPPUS HALLII, n. sp. Puberulo-scaber, multicaulis; caulibus (spithamæis et ultra ad apicem usque foliosis; foliis lanceolatis integerrimis apiculato-acuminatis rigidis, costa prominula; capitulis racemosis primum resinosis; involucro obconico vix semipollicari, squamis pluriseriali-imbricatis appressis lanceolatis acutis subglabris; ligulis 7–10-disco 10–12-floro vix longioribus; acheniis pubescentibus. — Specimens mostly too little developed: a species apparently quite new, connecting *Ericameria* with *Aplopappus* proper. Bluffs of Columbia River at the Dalles.

258. SOLIDAGO VIRGAUREA L. var. HUMILIS, connecting with the var. *alpina*.

259. SOLIDAGO ELONGATA Nutt., var. *β*. Torr. & Gray, Fl. 2, p. 223. Evidently a low plant.

260. SOLIDAGO GIGANTEA Ait. Quite like the Eastern plant.

261. Solidago occidentalis Nutt.; in two forms.

262. Chrysopsis villosa Nutt. Forms passing into *C. hispida.*

263. Chrysopsis (Ammodia Nutt.) Oregana Gray, Proc. Acad. 7, p. 543.

264. Grindelia hirsutula Hook. & Arn. Bot. Beech. p. 147.

265. Grindelia integrifolia DC.; Torr. & Gray, l. c.

266. Grindelia humilis Hook. & Arn. l. c.; a variety with more leafy and pubescent stem.

267. Grindelia discoidea Nutt. 268. A more slender form.

269. Baccharis pilularis DC. Prodr. 5, p. 407. Found for the first time in Oregon.

270. Psilocarphus Oreganus Nutt. "A common weed." 271. A remarkably large and luxuriant form. Probably all but *P. tenellus* are of one species.

272. Micropus Californicus Fisch. & Meyer; Torr. & Gray, Fl. 2, p. 265.

273. Fransenia bipinnatifida Nutt. 274. F. Hookeriana Nutt.; Torr. & Gray, l. c.

275. Wyethia robusta Nutt.; Torr. & Gray, l. c.

276. Balsamorhiza deltoidea Nutt.; Torr. & Gray, l. c.

277. Rudbeckia occidentalis Nutt.; Torr. & Gray, l. c.

278. Bidens cernua L., var. elata, Torr. & Gray; a low form of it.

279. Gaillardia aristata Pursh; Lindl. Bot. Reg. t. 1186.*

280. Bahia lanata Nutt.; a slender form.

281. Lasthemia glaberrima DC. Prodr. 5, p. 664. Seldom collected, not previously in Oregon.

282. Helenium autumnale L., var. grandiflorum Torr. & Gray, l. c.

283. Blepharipappus scaber Hook. Fl. Bor.-Am. 1, p. 316.

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* Chænactis brachypappa, n. sp. Corymboso-ramosa, tenuiter cinereo-pubescens, glabrescens; foliis longius petiolatis bipinnatipartitis, segmentis linearibus obtusis; pedunculis brevibus; involucri squamis linearibus obtusis disco subdimidio brevioribus; corollis albis, marginalibus ampliatis; antheris semi-exsertis; pappo simplici e paleis 4-5 quadratis subcuneatisve truncatis consimilibus corollæ tubo dimidio brevioribus (nunc fl. disci uno quandoque satis elatiore). In habit, size, &c., resembles *C. stevioides;* but leaves more compound and their segments divaricate, corolla apparently pure white and only 2½ lines long, and pappus remarkably short and truncate. — Discovered by Miss Searls in the Pahranagat Mountains, Nevada.

284. MADIA (MADARIA DC.) ELEGANS Don; chiefly the form which is *M. racemosa* Nutt., and a depauperate slender state of it.

285. MADIA (AMIDA Nutt.) GLOMERATA Hook. l. c. Includes *Amida gracilis* and *A. hirsuta* Nutt.

286. MADIA (ANISOCARPUS) NUTTALLII, *Anisocarpus madioides* Nutt. l. c.*

287. MADIA RACEMOSA Torr. & Gray, Fl. 2, p. 405. *Madorella racemosa* Nutt.

288. MADIA (HARPÆCARPUS) FILIPES. *Harpæcarpus madarioides* Nutt. This and the related *M. exigua* (*Sclerocarpus exiguus* Smith) form a marked section of the genus as now extended.

289. LAGOPHYLLA RAMOSISSIMA Nutt.; Torr. & Gray, Fl. 2, p. 402.

290. ACHILLEA MILLEFOLIUM L., a dwarf variety of high mountains. *A. tomentosa* Pursh.

0. COTULA AUSTRALIS Hook. f., Fl. N. Zeal. 1, p. 128. *Strongylosperma* DC. A few specimens, probably adventive; but the species is spreading widely over Pacific coasts.

291. ARTEMISIA DRACUNCULOIDES Pursh; Torr. & Gray, Fl. 2, p. 416.

292. ARTEMISIA CANADENSIS Michx.; Torr. & Gray, l. c.

293. ARTEMISIA LUDOVICIANA Nutt., var. LATIFOLIA Torr. & Gray. 294. Var. DOUGLASIANA Eaton in Watson, Bot. King (*A. Douglasiana* Besser), and another form near it.

295. ARTEMISIA DISCOLOR Dougl. in Hook, l. c. Only the tops of the plant, and of doubtful determination.

296. GNAPHALIUM (GAMOCHÆTA) PURPUREUM L.

297. GNAPHALIUM PALUSTRE Nutt. l. c. *G. gossypinum* Nutt. is the same plant.

298. GNAPHALIUM LUTEO-ALBUM L. *G. Sprengelii* Hook. & Arn. Bot. Beech.

299. GNAPHALIUM MICROCEPHALUM Nutt. l. c. A slender form.

300. GNAPHALIUM LEUCOCEPHALUM Gray, Pl. Wright, 2, p. 99. This and the last are new to Oregon.

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* MADIA BOLANDERI (as *Anisocarpus Bolanderi*, Gray, must be called in the re-arrangement of the Madioid genera) is surpassed in size of heads and rays by an allied Californian species having fertile disk-flowers, *M. radiata* Kellogg in Proc. Calif. Acad. 4, p. 190, Jan. 1872.

301. ANTENNARIA MARGARITACEA R. Br.; an unusually small form of this species.

302. ANTENNARIA DIOICA Gærtn.; and 303. A. ALPINA Gærtn.: female plants of both.

304. SENECIO SUBNUDUS DC.; Torr. & Gray, Fl. 2, p. 444.

305. SENECIO FASTIGIATUS Nutt.; Torr. & Gray, l. c. A pretty rare species.

306. SENECIO EXALTATUS Nutt. Probably a mere variety of *S. lugens*, to which it has been referred.

307. SENECIO TRIANGULARIS Hook. Fl. Bor.-Am. t. 115; a variety with smaller leaves and heads than the original, and with many of the upper leaves tapering to the base: wherefore it was thought to be the little-known *S. serra* Hook, l. c.; but that, according to Professor Oliver, has still smaller heads, and leaves gradually narrowed to the base.

308. ARNICA LATIFOLIA Bongard. *A. Menziesii* Hook. Fl. Bor.-Am. 1, t. 111. In various, mostly small, forms.

309. ARNICA AMPLEXICAULIS Nutt.; Torr. & Gray, l. c. Some of the specimens tall and remarkably leafy.

310. CIRSIUM EDULE Nutt. 311. C. REMOTIFOLIUM DC.; Torr. & Gray, l. c.; not well named.

312. CIRSIUM UNDULATUM Nutt.: Torr. & Gray, l. c.

313. CALAIS LACINIATA Gray, in Bot. Whippl. p. 57. *Scorzonella* Nutt.; Torr. & Gray, Fl. 2, p. 470.

314. APARGIDIUM BOREALE Torr. & Gray, Fl. 2, p. 474.

315. MACRORHYNCHUS HETEROPHYLLUS Nutt.; Torr. & Gray, l. c. Small and pubescent form, with outer achenia inclined to have undulated wings, as in Nuttall's description. 316. A small, less pubescent form. 317. Larger form; achenia merely ribbed.

318. MACRORHYNCHUS LESSINGII Hook. & Arn. A small form: *root obviously not annual.*

319. MACRORHYNCUS LACINIATUS Torr. & Gray, l. c.; a slender form, with finely cut leaves. 320. A larger form, answering to var. LONGIFOLIUS Torr. & Gray, l. c.

321. MACRORHYNCUS ELATUS Torr. & Gray, l. c.: form with broad merely pinnatifid-incised leaves.

322. STEPHANOMERIA PANICULATA Nutt.; Torr. & Gray, l. c.

323. HIERACIUM SCOULERI Hook. Fl. Bor.-Am. 1, p. 298.

324. HIERACIUM TRISTE Willd. *H. gracile* Hook. Fl. Bor.-Am. l. c.

325. Hieracium albiflorum Hook. Fl. Bor.-Am. 2, p. 297.

326. Hieracium umbellatum L.; Hook. l. c.

327. Malacothrix crepoides Gray, in Pacif. R. R. Expl. 12, p. 49.

328. Mulgedium pulchellum Nutt.; Torr. & Gray, Fl. 2, p. 497.

329. Mulgedium leucophæum DC.; Torr. & Gray, l. c.

330. Downingia elegans Torr. (*Clintonia elegans* Lindl.) Var. corymbosa. *Clintonia corymbosa* DC. Prodr. 7, p. 347.

331. Heterocodon rariflorum Nutt. in Trans. Amer. Phil. Soc. 8, p. 255.

332. Specularia perfoliata A. DC. *Dysmicodon* Nutt. l. c.

333. Githopsis specularioides Nutt. l. c., mixed with 334. Var. hirsuta, Nutt.

335. Campanula Scouleri Hook. Fl. Bor.-Am. 2, p. 28, t. 125.

336. Vaccinium ovatum Pursh; Lindl. Bot. Reg. t. 1354. In fruit.

337. Vaccinium myrtilloides Hook. l. c. (var. macrophyllum), not of Michx.

338. Vaccinium parvifolium Smith; Hook. l. c. t. 128. In fruit.

339. Vaccinium uliginosum L. In fruit.

340. Vaccinium cæspitosum Michx., var. angustifolium. *V. cuneifolium* Nutt. herb. A fine stock of specimens, in fruit, of a *Vaccinium* apparently common in the region, which at first sight seems distinct enough from *V. cæspitosum*, by its taller and bushy stems and narrower (in these specimens oblanceolate) leaves; but the two are connected by intermediate forms. I should take it to be *V. salicinum* of Chamisso, except that he describes the leaves of the Unalaschka plant as quite entire.

341. Arbutus Menziesii Pursh, Hook. l. c. In fruit.

342. Arctostaphylos tomentosa Dougl.; Hook. l. c. p. 130. In fruit.

343. Arctostaphylos pungens HBK.; Hook. Bot. Mag. t. 3027.

344. Arctostaphylos Uva-ursi Spreng., var. The large Western form, with mature fruit.

345. Gaultheria Shallon Pursh, Fl. 1, p. 284, t. 12.

346. Gaultheria Myrsinites Hook. l. c. t. 129. Mostly a large form, in fruit.

347. Menziesia ferruginea Smith, Ic. t. 56; a variety of *M. globularis* Salisb.

348. Ledum glandulosum Nutt. in Trans. Am. Phil. Soc. l. c. In fruit.

349. Rhododendron Californicum Hook. Bot. Mag. t. 4863. Flower and fruit.

350. Rhododendron albiflorum Hook. Fl. Bor.-Am. 2, p. 43, t. 133.

351. Pyrola minor L.; Hook. Fl. Bor.-Am. 2, p. 45.

352. Pyrola bracteata Hook. l. c. Specimens so well marked that one would think the species a very good one.

353. Pyrola picta Smith; Hook. l. c. In fruit.

354. Pyrola chlorantha Swartz? With ripe fruit only; a remarkable form, if of this species, with small oval leaves.

355. Chimaphila umbellata Pursh; Hook, l. c.

356. Chimaphila Menziesii Hook. l. c. t. 138.

357. Pleuricospora fimbriolata Gray, Proc. Am. Acad. 7, p. 368. A few specimens of this most interesting plant, gathered in deep woods, June 30, just coming into blossom. Plant said to have the taste of *Polygala Senega*. The short spike is at first nodding.

0. Allotropa virgata Torr. & Gray, l. c. A single specimen of this rare plant only collected.

358. Dodecatheon Meadia L. var.; one of the small Western forms.

359. Trientalis Europæa L., var. latifolia, *T. latifolia* Hook. l. c. 360. Var. arctica, *T. arctica* Fischer.

361. Centunculus minimus L. var. *C. lanceolatus* Michx. Not seen before west of the Rocky Mountains.

362. Plantago Patagonica, Jacq. var. gnaphalioides Gray, Man. ed. 5.

363. Utricularia vulgaris L.

364. Phelipæa pinetorum Gray, Proc. Am. Acad. 7, p. 371. *Orobanche pinetorum* Geyer.

365. Collinsia grandiflora Lindl. Bot. Reg. t. 1107; Hook. l. c. 366. Var. nana: spithamæa, ramosior, floribunda. (Of *C. parviflora* Dougl. only two or three specimens were collected.)

367. Tonella collinsioides Nutt. in DC. Prodr. 10, p. 593 (sub *Collinsia tenella*); Gray, Proc. Am. Acad. 7, p. 378.

368. Pentstemon Menziesii Hook., var. Lewisii; very dwarf form in flower. 369. Larger form, in fruit.

370. Pentstemon triphyllus Dougl.; Lindl. Bot. Reg. t. 1245.

371. PENTSTEMON RICHARDSONII Dougl. Lindl. Bot. Reg. t. 1121.

372. PENTSTEMON DIFFUSUS Dougl.; Lindl. Bot. Reg. t. 1132.*

373. SCROPHULARIA NODOSA L.

374. MIMULUS LUTEUS L.; the large form. 375. Small-flowered form of the same.

376. MIMULUS MOSCHATUS Dougl.; Lindl. Bot. Reg t. 1118.

377. MIMULUS FLORIBUNDUS Dougl.; Lindl. Bot. Reg. t. 1125.

378. MIMULUS ALSINOIDES Dougl.; Benth. in DC. Prodr. 10, p. 373. A well-marked species, which I have not before received, mostly more luxuriant specimens than Douglas's plant appears to be, and none of the peduncles "much longer than the leaves," most of them barely equalling the leaf, but then the petiole is very slender.

379. GRATIOLA EBRACTEATA Benth. in DC. Prodr. 10, p. 595.

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* The three following species were in Miss Searls's collection made in the Pahranagat Mountains, S. E. Nevada: —

PENTSTEMON PALMERI Gray, Proc. Am. Acad. 7, p. 379. From the dried specimens and from the report of Mr. Watson this should be "an exceedingly handsome species," but in cultivation here thus far it is not quite so showy as might have been expected: the flowers are elegant, but almost white.

PENSTEMON CÆSPITOSUS Nutt., var.? INCANUS: foliis brevioribus sursum sæpius latioribus (obovato-spathulatis) cum sepalis ovato-oblongis pube creberrima canescentibus; pedunculis brevibus unifloris erectis. Very likely a distinct species.

PENTSTEMON EATONI, n. sp. Quoad folia et inflorescentia virgata *P. barbato* simillimus, sed pedunculis pedicillisque brevioribus *P. centranthifolii;* corolla (coccinea raro alba) sensim ampliata imberbi labiis brevibus erectis parum inæqualibus *P. imberbis* modo, sed antheræ loculis divergentibus, filamento sterili hinc barbulato. — *P. centranthifolius* S. Watson, Bot. King, p. 219, non Benth. — Of this species I received a flower several years ago, from some now forgotten source, and referred it to *P. imberbis:* consequently I did the same upon receiving a specimen collected in Arizona by Dr. E. Palmer. Mr. Watson, who, in company with Professor Eaton, found it abundantly in Provo Cañon, Wahsatch Mountains, referred it to the Californian *P. centranthifolius*. But, besides other distinctions, it has the characteristic anthers of the *Elmigera* group, to which it adds a third species. The cells of the anther diverge widely, and are much larger than those of *P. imberbis:* their dehiscence stops well short of the apex. Upon this the character of the section rests; for in this species, as in the Mexican one just mentioned, the lower lip of the corolla is not at all decurved, apparently not even patent. Specimens have been distributed under the name of *P. miniatus*, Lindley's plant of that name, in the last volume of the Botanical Register, having been overlooked. As it is likely to be brought into the gardens, and perhaps to be as great a favorite as its relatives, *P. barbatus* and the variety *Torreyi*, I take pleasure in having it bear the name of Professor D. C. Eaton, one of its discoverers.

380. Ilysanthes gratioloides Benth. in DC. l. c. Not before found west of the Rocky Mountains.

381. Veronica Americana Schweinitz, Benth. in DC. l. c. 382. Veronica scutellata L.

383. Veronica alpina L. Sparingly collected.

384. Veronica serpyllifolia L. Apparently indigenous.

385. Synthyris reniformis Benth. l. c. *Wulfenia reniformis* Hook. Fl. Bor.-Am. 2, t. 171. Fine specimens, both in flower and fruit, of this rare plant.

386. Orthocarpus pusillus Benth. in DC. Prodr. p. 535. Collected in Oregon also by Nuttall and in Wilkes's Expedition.

387. Orthocarpus bracteosus Benth. l. c. Corolla bright purple.

388. Orthocarpus hispidus Benth. l. c. Large form, and slender specimens, the latter, I fear, not distinct from *O. attenuatus* Gray.

389. Castilleia parviflora Bongard, the *C. hispida* Benth.

390. Castilleia pallida Kunth, var. miniata Gray in Sill. Jour. Two forms.

391. Pedicularis racemosa Dougl. in Hook. Fl. Bor.-Am. 2, p. 108.

392. Pedicularis Grœnlandica Retz., var. surrecta. *P. surrecta* Benth.

393. Verbena bracteosa Michx.

394. Mentha Canadensis L.: both forms.

395. Lycopus Virginicus L., with some specimens of the var. macrophyllus (*L. macrophyllus* Benth.), or nearly it, as well as of the depauperate form, *L. uniflorus* Michx.

396. Lycopus sinuatus Ell. *L. Europæus* var. *sinuatus* Gray, Man., but a good species.

397. Micromeria Douglasii Benth.: Hook. l. c.

398. Scutellaria antirrhinoides Benth. l. c. The only genuine specimens I have seen. Distinguished from the broader-leaved forms of *S. angustifolia* by its smaller and especially shorter corolla, its tube enlarging gradually immediately above the calyx. Bentham indeed says that the flowers are just those of that species; but the difference here indicated probably holds good. It is still more marked in a var. Californica, a more erect, rigid, and commonly larger form, with corolla (seemingly yellowish instead of blue) decidedly ventricose from a broader tube. This has been collected by Fremont,

Bigelow, Bolander, Rattan, Bridges, and Torrey; and Hartweg's no. 1918, referred by Bentham to *S. angustifolia*, is a narrow-leaved form of it.

399. SCUTELLARIA LATERIFLORA L.

400. STACHYS CILIATA Dougl.; Hook. Fl. Bor.-Am. 2, p. 116.

401. STACHYS PALUSTRIS L.; Hook. l. c.

402. TRICHOSTEMA OBLONGUM Benth., and 403. T. LANCEOLATUM Benth. l. c.

404. AMSINCKIA LYCOPSOIDES Lehm.; DC. Prodr. 10, p. 117.

405. MERTENSIA PANICULATA Don; Gray in Sill. Jour. 34, p. 340. Chiefly in fruit.

406. ERITRICHIUM PLEBEIUM A. DC. Prodr. 10, p. 133.

407. ERITRICHIUM CALIFORNICUM A. DC. l. c. Doubtless passes into the next, which has the oldest name.

408. ERITRICHIUM CHORISIANUM A. DC. l. c. Has more distinct pedicels and larger corolla than the last.

409. ERITRICHIUM FULVUM A. DC. *Myosotis* (*Dasymorpha*) *tenella* Nutt.; Hook. Pl. Geyer.

410. ERITRICHIUM MURICULATUM A. DC. l. c. *Myosotis muricata* Hook. & Arn.

411. PLAGIOBOTHRYS CANESCENS Benth. Pl. Hartw. p. 326.

412. NEMOPHILA PARVIFLORA Benth.; Hook. Fl. Bor.-Am. 2, p. 79. — A few specimens were gathered of *Hydrophyllum macrophyllum* var. *occidentale* S. Watson in Bot. King, p. 248, along with a form that seemingly passes into *H. Virginicum*.

413. ROMANZOVIA SITCHENSIS Bongard, Veg. Sitcha, t. 4.

414. PHLOX DOUGLASII Hook., nearly var. DIFFUSA Gray Proc. Am. Acad. 7, p. 254, i. e. *P. diffusa* Benth. Pl. Hartw. p. 325, which synonyme was inadvertently omitted in the monograph above referred to.

415. COLLOMIA GRANDIFLORA Dougl. in Lindl. Bot. Reg. t. 1174.

416. COLLOMIA LINEARIS Nutt.; Lindl. Bot. Reg. t. 1166. In fruit.

417. COLLOMIA GRACILIS Dougl. *Gilia gracilis* Hook. Bot. Mag. t. 2924.

418. COLLOMIA HETEROPHYLLA Hook. Bot. Mag. t. 2895, Gray, l. c.

419. GILIA (LEPTOSIPHON) TENELLA Benth. Pl. Hartw. l. c.; Gray, l. c.

420. GILIA (NAVARRETIA) SQUARROSA Hook. & Arn. Bot. Beechey, p. 151.

421. GILIA (NAVARRETIA) INTERTEXTA Steud.; Gray, l. c.

422. GILIA CAPITATA Dougl.; Hook. Bot. Mag. t. 2698.

423. NICOTIANA MULTIVALVIS Lindl. Bot. Reg. t. 1057.

424. ERYTHRÆA NUTTALLII S. Watson, Bot. King, Expl. p. 277, t. 29. I presume that this is also *Cicendia exaltata* Griseb. in Hook. Fl. Bor.-Am. 2, p. 69, t. 157, and that the characters "stylo nullo" and "stigmate vix distinguendo" were based in some way upon the imperfection of the specimen, — the style perhaps broken off. The anthers are linear-oblong, and as much twisted when dry as in several other species of *Erythræa*. The stigma is actually that of Grisebach's section *Euerythræa*, in these specimens much more divided than in Watson's figure. 425. Var. TENELLA. A smaller form, one to three inches high.

426. GENTIANA AFFINIS Griseb. in Hook. l. c. p. 56.

427. APOCYNUM ANDROSÆMIFOLIUM L.: the Western form.

428. ASCLEPIAS SPECIOSA Torr. Ann. Lyc. N. Y. *A. Douglasii* Hook. Fl. Bor.-Am. 2, p. 33, t. 142.

429. ASCLEPIAS FASCICULARIS Decaisne in DC. Prodr. 8, p. 569.

430. FRAXINUS OREGANA Nutt. Sylv. 3, p. 59, t. 99.

431. ASARUM CAUDATUM Lindl. Bot. Reg. sub t. 1399. *A. Hookeri* Fielding & Gardn. Sert. t. 32.

432. ATRIPLEX LITTORALIS L.: narrow-leaved variety, in few specimens.

433. ATRIPLEX (OBIONE) TRUNCATA. *Obione truncata* Torr. in Watson, Bot. King, Expl. p. 291. Two or three specimens of the typical plant: those distributed are — Var. STRICTA: foliis hastato-lanceolatis nunquam cordatis, inferioribus basi cuneatis; inflorescentia virgata minus foliata. *A. patula* var. foliis magis argento-furfuraceis Hook. Fl. Bor.-Am. 2, p. 128, ex char. The fruit (indurated theca), as in the Nevadan specimens, is 3 – 4-toothed at the truncate summit, the teeth variable, middle one rarely a little produced, and some tubercles occasionally developed on the disk.

434. AMARANTUS RETROFLEXUS L. var. *A. occidentalis* Nutt. herb.; a depauperate and smooth form.

435. ERIOGONUM COMPOSITUM Dougl. in Benth. Eriog. t. 17; Gray, Rev. Eriog. in Proc. Am. Acad. 8, p. 159. In fruit.

436. ERIOGONUM UMBELLATUM Torr.; Gray, l. c.

437. ERIOGONUM NUDUM Dougl. in Benth. l. c.; Gray, l. c. p. 167. The type of the species.

438. ERIOGONUM ELATUM Dougl. in Benth. Eriog. l. c.; Gray, Rev. Eriog. l. c. p. 168.

439. ERIOGONUM DICHOTOMUM Dougl. l. c.; Gray, l. c. p. 175.

440. ERIOGONUM VIMINEUM Dougl. l. c.: Gray, l. c. p. 177.

441. RUMEX SALICIFOLIUS Wimm.; Hook. l. c.*

442. RUMEX ACETOSA L.; Hook. Fl. Bor.-Am. 2, p. 129; sparingly collected.

443. POLYGONUM NODOSUM Pers.; Meisn. in DC. l. c.

444. POLYGONUM AMPHIBIUM L., var. TERRESTRE Willd.

445. POLYGONUM BISTORTA L.; Hook. Fl. Bor.-Am. l. c.

446. POLYGONUM DAVISIÆ Brewer, n. sp. (Fl. Calif. ined.) A remarkable species, with a low, branching, commonly zigzag, very

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* RUMEX BRITANNICA L. I think I have been able to determine the *Rumex* to which Linnæus gave this unfortunate name. The source of the name is to be found by following up his reference to "*Mat. Med.* 17," i. e. Materia Medica, paragraph 177 (not 17), where, under reference to Fl. Suec. 292, "Europæ nostræ paludes," is added "*Pharm. Herbæ Britannicæ radix.*" The North American plant to which he applied this name was one in his herbarium sent to him by Gronovius from Clayton's herbarium of the Flora Virginica. The fruit of it is not well developed, but the slender pedicels and the foliage show that it is the *R. orbiculatus* of the later edition of my Manual. But the specimen retained in Clayton's herbarium to represent the species, and the only Rumex in that herbarium, is quite different, has some long-awned teeth to the valves, and is, as I believe, *R. obtusifolius*. The difference in the plants accounts for the remark of Linnæus: "Plantam Gron. in Fl. Virginica habui a Cl. Authore, quæ non rubra erat caule aut costis." For Clayton's character, as printed by Gronovius in the first edition of Flora Virginica, was: — "Lapathum foliis longis latis vix acuminatis, *costis caulibusque rubentibus,* radice intus crocea." That probably relates to the plant retained by Gronovius. And the specimen sent was perhaps Clayton's other species, viz., — "Lapathum aquaticum foliis longis," &c., which Linnæus referred to *R. verticillatus*. As to the *R. Britannica* of Michaux, Pursh, and even Meisner, it is uncertain whether they had in view the plant called by me in the Manual by that name, but named by Professor Wood *R. altissimus*, or that which Wood and probably Pursh took for *R. Britannica*, and I named *R. orbiculatus*. The latter proves to be the Linnæan species, and must claim the name, unless that be regarded as a *nomen falsum*, in which case we must take up that of *R. Claytoni* Campdera, who may be presumed to have meant the Linnæan plant, although there is nothing in his character to certify it. A considerable difficulty in identifying the Linnæan species by the description grew out of the comparison in the species Plantarum with *R. verticillatus*, with which when in fruit it has little in common, except the slender pedicels. It should also be noticed that there is a transposition in the naming of the specimens in the Linnæan Herbarium, which, however, has been corrected by Smith.

leafy stem, in these specimens more pubescent than in those from California, and the flowers more numerous and spicate. It was thought to be of the *Avicularia* section, but the present specimens refer it rather to the section *Aconogonon*, along with *P. alpinum* or *polymorphum*. Professor Brewer describes the root as annual, which I should hardly suppose; the leaves are mostly sessile, ovate, 1 to 2 or even 3 inches long; ochreæ chestnut-colored, obliquely truncate. Perianth barely a line long, tapering to a very acute or almost stipitate base: achenium smooth, with broad faces, twice the length of the perianth. In California it belongs to the Sierra Nevada: it was collected by Professor Brewer himself, Professor Torrey, and by Miss N. J. Davis, to whom it is appropriately dedicated.*

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* Professor Brewer arranges the Californian *Polygona* of the *Avicularia* section into: —

1. Annuals, with stems not at all striate: *P coarctatum* Dougl. and *P. Californicum* Meisner.

2. Annuals, with stems striate, at least towards the base: *P. tenuis* Michx., *P. ramosissimum* Michx., and *P. aviculare* L.

3. Perennials, with stems woody at base, and branches slender; bark chestnut-brown: *P. Paronychia* Cham. & Schlecht., and the two following new species.

" P. SHASTENSE, Brewer. Woody; branches prostrate; leaves lanceolate, plane or at least not revolute, either blunt or acute: sheaths inconspicuous, scarious and much torn: flowers in a very loose leafy spike, 1 – 3 in an axil, 2 – 3 lines long, on pedicels nearly or quite as long: styles ¼ the length of the ovary or less. The base of the crabbed stem is of very hard dark wood, sometimes half an inch in diameter. Branches prostrate, crooked, rough with old leaf-scars, 4 – 8 inches long and a line or less in diameter, leafless except for the inch or two near the end. Joints usually but 1 or 2 lines long. The silvery sheaths are very inconspicuous. Flowers conspicuous, white, bright rose, or red. Perianth tapering to a very acute or almost stipitate base which is sometimes corrugated; the segments broadly obovate or orbicular, sometimes emarginate, veined, usually deepest colored along the middle. The 2 or 3 outer segments are channelled, making the flower triangular. Sierra Nevada in exposed places, on dry ashy soil, Mt. Shasta to Carson Pass, *Torrey, Brewer*.

" P. BOLANDERI, Brewer. Woody; branches erect and slender, with numerous lateral flowering spikes above: leaves minute, cuspidate-mucronate; sheaths nerveless, scarious and much torn: flowers commonly solitary in the axils, 1½ lines long, on pedicels ¼ as long, rather acute at the base, the segments elliptical and 1-nerved; styles ¼ as long as ovary or less. — The gnarled and crabbed base is often an inch or more in diameter and of very hard wood, bearing broomlike tufts of very slender woody branches. These are very numerous, erect, nearly straight, 10 – 18 inches high, wiry or filiform, half a line in diameter, the joints 6 – 10 lines long, almost naked below, and bearing at nearly every upper node a

447. POLYGONUM AVICULARE L. A native form of the species?

448. POLYGONUM RAMOSISSIMUM Michx.; a tall, yellowish form.

449. POLYGONUM TENUE Michx., with a larger-flowered variety peculiar to the western side of the continent, *P. racemosum* Nutt. herb. 450. A low form, with more crowded and showy blossoms. 451. A somewhat similar form. 452. An undetermined, probably undescribed species of this section.

453. POLYGONUM COARCTATUM Dougl. in Hook. Fl. Bor.-Am. 2, p. 133.

454. POLYGONUM CONVOLVULUS L. Apparently native.

455. COMANDRA UMBELLATA Nutt. Quite like the Eastern plant.

456. PHORADENDRON FLAVESCENS Nutt., var. VILLOSUM Engelm. *P. villosum* Nutt. and *P. tomentosum* Engelm.

457. ARCEUTHOBIUM ABIETINUM Engelm. n. sp.; male specimens. 458. Female specimens. On *Abies grandis*, Willamette Valley.

459. CALLITRICHE MARGINATA Torr. Bot. Whippl. p. 79.

460. CALLITRICHE VERNA L.

461. CALLITRICHE BOLANDERI Hegelm., apparently. Stigmas elongated.

461ª. CALLITRICHE AUTUMNALIS L. With young fruit.

462. EREMOCARPUS SETIGERUS Benth. Bot. Sulph. p. 53, t. 26. *Croton setigerus* Hook. Fl. Bor.-Am.

463. EUPHORBIA GLYPTOSPERMA Engelm. in Bot. Mex. Bound. p. 187.

464. EUPHORBIA SERPYLLIFOLIA Pers.: a narrow-leaved form, with distinctly scrobiculate seeds. 465. A broader-leaved form, with seeds obscurely scrobiculate.

466. CELTIS RETICULATA Torr.; Nutt. Syl. 1, t. 39. In fruit.

467. CASTANOPSIS CHRYSOPHYLLA A. DC. *Castanea chyrsophylla* Dougl. in Hook. Fl. Bor.-Am. 2, p. 159.

467ª. CORYLUS ROSTRATA Ait., var. CALIFORNICA A. DC. Beak of fruit much shorter than in the Eastern species.

468. MYRICA CALIFORNICA Cham. & Schlecht.; Hook. Fl. Bor.-Am. 2, p. 160.

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flowering spikelet. Leaves 2-3 lines long, half a line wide, thickish, the point bayonet-like, those of the flowering spikelets nearly concealed by the sheaths. The spikelets are 6-10 lines long and very numerous, silvery or tawny, with the conspicuous sheaths contrasting beautifully with the chestnut-colored bark of the branches. —Very dry rocky hills east of Napa Valley, California, *Brewer, Bolander*."

469. BETULA PUMILA L.; Regel in DC. Prodr. 16, p. 173.

470. ALNUS RUBRA Bongard; Regel. l. c. p. 186.

471. SALIX LANCEOLATA Anders. Sal. Monogr. & in DC. Prodr. 16, p. 206, ex char. With mature fruit.

472. SALIX LONGIFOLIA Muhl.; Anders. l. c. var.

473. SALIX SITCHENSIS Bongard; Anders. l. c. With ripe catkins only an inch or two long.

(SALIX CHLOROPHYLLA var. PELLITA Anders. in DC. l. c. p. 243. One or two specimens collected, in fruit.)

474. SALIX SESSILIFOLIA Nutt., var. VILLOSA Anders. in DC. l. c. p. 215?

475. PINUS CONTORTA Dougl.; the narrow-leaved, true Douglasian species. 475^a. A mountain form with broader leaves.

476. PINUS PONDEROSA Dougl., the original Douglasian form, according to Dr. Engelmann, with ripe cones.

477. PINUS MONTICOLA Dougl.: foliage and old cones.

478. PINUS ALBICAULIS Engelm.; with male flowers only. Higher elevations of Mount Hood.

479. ABIES GRANDIS Dougl., forma LASIOCARPA Hook. (A. *bifolia* Murray,) from the upper part of Mount Hood.

480. ABIES (TSUGA) PATTONIANA Jeffrey, Gordon. *A. Williamsonii* Newberry.

481. ABIES (TSUGA) DOUGLASII Lindl. In fruit.

482. ABIES (TSUGA) MERTENSIANA Lindl. In fruit.

483. THUYA GIGANTEA Nutt. Sylv. 3, t. 111; Hook. Fl. Bor.-Am. 1, p. 165.

484. JUNIPERUS COMMURIS L. var., ALPINA Parl. in DC. Prodr. 16, p. 480.

485. TAXUS BREVIFOLIA Nutt. Sylv. 3, p. 86, t. 108. The *Coniferæ* were mostly determined by Dr. Engelmann.

486. POTAMOGETON NATANS L.; Hook. Fl. Bor.-Am. 2, p. 171.

487. POTAMOGETON CLAYTONII Tuckerman; Robbins in Gray Man. p. 485.

488. POTAMOGETON RUFESCENS Schrader; Hook. Fl. Bor.-Am. p. 172. 488^a. A large form?

489. POTAMOGETON PERFOLIATUS L.; Hook. l. c 490. Var. LANCEOLATUS Robbins in Gray, Man. l. c.

491. POTAMOGETON COMPRESSUS L. *P. zosteræfolius* Schumacher, Hook. l. c.

492. POTAMOGETON PUSILLUS L. Dry fruit slightly keeled. 493. Var.? with fruit rounded and even on the back, and with a subdorsal nerve on each side.

494. POTAMOGETON PECTINATUS L.; Hook. l. c. In a pond at the Dalles of the Columbia.

495. POTAMOGETON ROBBINSII Oakes; Robbins in Gray, Man. p. 490. With flowers and some well-formed fruit! The latter has hardly been collected before.

496, 497. LEMNA MINOR L. 498. L. POLYRRHIZA L.

499. LYSICHITON KAMSTCHATENSE Schott. *Arctiodracon* Gray. *Symplocarpus* Bongard. Three or four scapes and leaves of this rare plant only collected.

500. SPARGANIUM SIMPLEX Hudson; Engelm. in Gray, Man.

501. ALISMA PLANTAGO L., var. AMERICANUM Gray, Man. l. c.

502. SAGITTARIA VARIABILIS Engelm. in Gray, Man. l. c.: large form.

503. ANACHARIS CANADENSIS Planchon; narrow-leaved form: sterile.

504. HABENARIA HYPERBOREA R. Br.; a slender form.

505. HABENARIA DILATATA Gray in Sill. Jour. p. 311, &c. With bright white flowers.

506. HABENARIA ELEGANS. *Platanthera elegans* Lindl. Gen. & Spec. Orch. p. 285.

507. HABENARIA FŒTIDA S. Watson, Bot. King Expl. p. 31. *Platanthera fœtida* Geyer in Hook. Kew Jour. Bot. 7, p. 376.

508. GOODYERA MENZIESII Lindl. l. c. *Spiranthes decipiens* Hook. Fl. Bor.-Am. 2, t. 204.

509. SPIRANTHES ROMANZOVIANA Chamisso; Gray, Man. p. 504.

510. LISTERA CORDATA R. Br. A few specimens of the larger western form.

511. CORALLORHIZA MULTIFLORA Nutt.; Hook. l. c.

512. CORALLORHIZA MERTENSIANA Bongard; Hook. l. c. A well-marked species, scantily collected, as well as the next.

512^a. CORALLORHIZA STRIATA Lindl. Gen. & Sp. Orch. p. 534. *C. Macræi* Gray, Man., is clearly the same.

513. CYPRIPEDIUM PASSERINUM Richardson; Hook. l. c. p. 205.

514. IRIS TENAX Dougl. in Bot. Reg. t. 1218.

515. SISYRINCHIUM TINCTORIUM HBK.; Klatt in Linnæa, 23, p. 82. *S. lineatum* Torr. A yellow-flowered species.

516. Trillium ovatum Pursh, Fl. 1, p. 245. In fruit.

517. Trillium sessile L. var. chloropetalum Torr. Bot. Whippl. p. 95. Mostly in fruit.

518. Scoliopus Bigelovii Torr. Bot. Whippl. p. 89, t. 22. Foothills of the Cascades, along mossy banks of streams. Copious specimens of this most rare plant were collected, but past flowering, i. e. the perianth and hypogynous stamens fallen: one or two specimens fortunately have ripe fruit. The thin-walled pericarp appears to open irregularly, not by any of the six sutural lines, but as it were between them, or near the three stronger and seminiferous sutures; and it would seem that the walls at length vanish, leaving the placentæ like a replum, sometimes united at apex by the persistent style, which is much more distinct and slender than in Dr. Torrey's figure, more so indeed than in Dr. Bigelow's specimens. The leaves also in the present specimens are smaller and narrower at base; but there is probably no specific difference. The characters of the fruit and seeds are appended.*

519. Clintonia uniflora. *Smilacina uniflora* Hook. Fl. Bor.-Am. 2, p. 175, t. 190.

520. Prosartes Hookeri Torr. Bot. Whippl. p. 88. In fruit; but apparently of this species. Some may be *P. Smithii* (*Uvularia* Hook. l. c. t. 189), of which two flowering branches were collected.

521. Streptopus roseus Michx. Fl. 1, p. 201, t. 18.

522. S. amplexifolius DC. Both species in fruit.

523. Smilacina bifolia Ker; the Pacific coast form, more like the European than is our Eastern one.

524. Lilium Canadense L.? A Western form, apparently between this and *L. superbum*.

525. Calochortus elegans Pursh; Hook. l. c. p. 183; both the vars. minor and major.

526. Brodiæa grandiflora Smith; Hook. Bot. Mag. t. 2877.

527. Brodiæa multiflora Benth. Pl. Hartw. p. 339.

528. Milla (Hesperoscordon) hyacinthina Baker in Jour. Linn. Soc. 11, p. 385. *Hesperoscordon Lewisii* Hook. l. c.

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* Scoliopus Torr. char. fruct. — Capsula tenuis, ovata, stylo brevi acuminata, irregulariter (sæpe longitudinaliter) fatiscens, oligosperma. Semina adscendentia, oblonga, subcurvata; testa nucleo conformi leviter sinuoso-striata; chalaza majuscula depressa; rhapne (haud prominula) crista lineari scariosa ut videtur bilamellata appendiculata! Embryo minimus, oblongus, in albumine corneo hilo proximus.

529. CAMASSIA ESCULENTA Lindl.; Hook. l. c. With mature fruit.

530. ALLIUM ACUMINATUM Hook. Fl. Bor.-Am. 2, t. 196.

531. ALLIUM SERRATUM S. Watson, Bot. King Expl. p. 487, t. 37, f. 4, 5.

532. TOFIELDIA GLUTINOSA Willd.; Hook. Fl. Bor.-Am. 2, t. 191.

533. XEROPHYLLUM SETIFOLIUM Michx., var. Lindl. Bot. Reg. t. 1613. *X. tenax* Pursh, Fl. 1, t. 9. In fruit.

534. ZYGADENUS NUTTALLII Gray; Watson, l. c. *Amianthium Nuttallii* Gray, Melanth. Rev.

535. STENANTHIUM OCCIDENTALE, n. sp. Caule subaphyllo (semipedali ad bipedalem) gracili; foliis aut lineari- aut lato-lanceolatis basi attenuatis; racemo laxifloro seu panicula simplici; pedicellis gracilibus mox nutantibus bracteam longe superantibus; perianthio purpureo-flavescente, phyllis lanceolatis ultra medium campanulato-conniventibus apice recurvo attenuato-acuminatis; seminibus utrinque anguste alatis. — Collected in the "Rocky Mountains" by Bourgeau, 1858; and "Cascade Mountains, lat. 49°, 1859, Kootenay, 1860, Rocky Mountains lat. 49° at 6000 feet above the level of the sea, 1861," Dr. Lyall; and now by Mr. Hall in the foothills of these mountains, upon mossy banks of streams. A striking species. Flowers from 6 to 20 in the raceme or simple panicle, polygamous, over half an inch long: perianth apparently greenish purple with the recurved tips yellowish. Pedicels longer than the flowers and the more or less scarious bracts, slightly thickened at the apex. Ovary free from the perianth except the extreme base. Mature capsule an inch long, including the slender persistent styles. Seeds with the narrow wing 3 to 4 lines long.

536. JUNCUS EFFUSUS L.: with open panicle. 537. Var. BRUNNEUS Engelm. Rev. Junc. p. 491; a slender form.

538. JUNCUS PATENS E. Meyer.; Engelm. l. c. p. 443.

539. JUNCUS DRUMMONDII E. Meyer; Engelm. l. c. p. 444.

540. JUNCUS TENUIS Willd., var. SECUNDUS Engelm. l. c. 541. Var. CONGESTUS Engelm. l. c. Two extremely marked forms.

542. JUNCUS BUFONIUS L.

543. JUNCUS TRIFORMIS Engelm. l. c. p. 492. Collected in immense abundance.

544. JUNCUS FALCATUS E. Meyer; Engelm. l. c. p. 452 & 495. 545. Larger and capitate form, with mature fruit.

546. JUNCUS LONGISTYLIS Torr. Bot. Mex. Bound. p. 223; Engelm. l. c. In small quantity, at the Cascades.

547. JUNCUS ACUMINATUS Michx.; Engelm. l. c. 548. A form of the same.

549. JUNCUS MERTENSIANUS Bongard, Veg. Sitch. p. 167; Engelm. l. c. p. 479.

550. JUNCUS XIPHIOIDES E. Meyer; Engelm. l. c. p. 481.

551. JUNCUS OXYMERIS Engelm. l. c. p. 483.

552. LUZULA SPADICEA DC., var. PARVIFLORA. 553. Var. MELANOCARPA (*L. melanocarpa* Desv.).

554. LUZULA COMOSA E. Meyer; slender forms, appearing different from the next. 555. A dwarf form.

556. LUZULA CAMPESTRIS Desv.: a dark-colored form.

557. CYPERUS INFLEXUS Muhl. 558. CYPERUS OCCIDENTALIS Torr. Mon. Cyp. p. 259.

559. DULICHIUM SPATHACEUM Pers. Not before received from west of the Rocky Mountains.

560. ELEOCHARIS ACICULARIS R. Br. 561. E. PALUSTRIS R. Br.: large form.

562. SCIRPUS LACUSTRIS L. 563. S. MICROCARPUS Presl; Gray, Man. p. 564 (*S. lenticularis* Torr.).

564. SCIRPUS (ISOLEPIS) PYGMÆUS Gray, Proc. Am. Acad. 7, p. 392. *Isolepis leptocaulis* Torr.

565. FIMBRISTYLIS CAPILLARIS Gray: a small state.

566. FIMBRISTYLIS; a minute species, apparently the same as one which has already been collected in California, but unpublished: the specimens for comparison not at hand.

567. CYPERUS ACUMINATUS Torr. Mon. Cyp. p. 436. New to the Pacific coast; a small form.

568. RHYNCHOSPORA ALBA Vahl.

569.* CAREX NIGRICANS C. A. Meyer, Cyp. Nov. in Act. Petrop. 17, t. 7.

570. CAREX BREWERI Boott, Ill. Car. 4, p. 142, t. 55.

571. CAREX POLYTRICHOIDES Muhl.; Boott, l. c. t. 469.

572. CAREX HOOKERIANA Dewey; Hook. Fl. Bor.-Am. t. 212.

573. CAREX STIPATA Muhl.

574. CAREX KUNZEI Olney, ined. *C. leiorhyncha* Kunze, Supp. Car. t. 2, fig. 1, non C. A. Meyer.

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* These *Carices* are determined by S. T. Olney, Esq., of Providence, who is making a very critical study of the North American species.

575. Carex Douglasii Boott, in Hook. l. c. t. 214; all male plants.

576. Carex vitilis Fries, var. alpicola, Wahl.

577. Carex Bolanderi Olney in Proc. Am. Acad. 7, p. 393. *C. Hartwegi* Dewey, non Boott. 578. Var. elongata Olney. 579. Var. minor Olney. 580. Var. sparsiflora Olney.

581. Carex tenella Schkuhr. *C. disperma* Dewey.

582. Carex echinata Murray, Comm. Gœtt. 1770. *C. stellulata* Good. 1792.

583. Carex leporina L. var. Americana.

584. Carex festiva Dewey. 585. Var. minor Olney. 586. Var. gracilis Olney. *C. propinqua* Boott in Bot. Whippl., non Nees & Meyen.

587. Carex athrostachya Olney l. c.? Fruit too broad and color browner.

588. Carex scoparia Schkuhr; Boott, Ill. Car. t. 368.

589. Carex lagopodioides Schkuhr; Boott l. c. t. 370.

590. Carex albolutescens Schw., var. brunnea Olney. 591. Var. sparsiflora Olney.

592. Carex Sitchensis Prescott; Boott, Ill. Car. t. 518, 519.

593. Carex cæspitosa L. But the perigynium slightly toothed at the apex.

594. Carex elata Allioni, 1785. *C. stricta* Good. 1792.

595. Carex borealis Lang, 1843, ex Anderss. Cyp. Scand. 596. A rather stouter form of the same?

597. Carex vulgaris Fries? The scale perhaps too pointed.

598. Carex decidua Boott, Ill. Car. 1, p. 63, t. 170.

599. Carex Mertensii Prescott; Boott, Ill. Car. 4, p. 212.

600. Carex ferruginea Schkuhr. Not *C. sempervirens* Vill.

601. Carex frigida Allioni; Boott. Ill. Car. 4, p. 208.

602. Carex laxiflora Lam. var. plantaginea Boott.

603. Carex Rossii Boott, Ill. Car. 2, p. 99, t. 205.

604. Carex Pennsylvanica Lam. Some specimens have a long-pedunculate lower spike.

605. Carex Oregonensis, n. sp. Olney, ined.

606. Carex amplifolia Boott, Ill. Car. 1, p. 17, t. 48.

607. Carex lanuginosa Michx.; Boott, l. c. t. 129.

608. Carex vesicaria L., var. lanceolata Olney. Achenium resembling that of Boott, Ill. Car. t. 537 fig. e., rather than the

admirable one found in Schkuhr. Riedgr. fig. 106. 609. Var. GLOBOSA Olney, ined.

610. PHLEUM ALPINUM L.; Hook. Fl. Bor.-Am. 2, p. 234.

611. ALOPECURUS PRATENSIS L.: a slender form, like that collected in California by Bolander.

612. CINNA ARUNDINACEA L., var. PENDULA Gray, Man. *C. pendula* Trin.

613. AGROSTIS PALLENS Trin.? This Prof. Thurber names *A. exarata* Trin.

614. AGROSTIS EXARATA Trin., a long-awned variety, according to Prof. Thurber. It is the *Deyeuxia alopecuroides* of Nuttall's herbarium, which was published by Mr. Buckley.

615. AGROSTIS ALBA L. A broad-leaved form.

616. AGROSTIS SCABRA Willd. *A. laxiflora* Richard.

617. AGROSTIS CANINA L.

618. AGROSTIS ÆQUIVALVIS Trin. Agrost, p. 116, fide Thurber: who now refers to it his own *A. Hillebrandii*, in Coll. Bolander, — an attenuated pale-green form. The "valves" are by no means equal.

619. AGROSTIS EXARATA Trin.: one of the forms of this polymorphous species according to Prof. Thurber.

620. VILFA DEPAUPERATA Torr. in. Hook. Fl. Bor.-Am. 2, p. 257, t. 236: but occasionally the paleæ are pointed as in *V. cuspidata* Torr., into which it may pass.

621. SPOROLOBUS CRYPTANDRUS Gray, Man. ed. 5, p. 610. 622. Same with open panicle.

623. CALAMAGROSTIS ALEUTICA Trin.; Hook. Fl. Bor.-Am. 1, p. 241.

624. POLYPOGON MONSPELIENSIS Desv.

625. STIPA OCCIDENTALIS Thurber; Watson Bot. King, p. 380.

626. SPARTINA CYNOSUROIDES Willd. 627. S. GRACILIS Trin. The latter is named *S. polystachya* in Hooker's List of Geyer's Plants, and is doubtless *S. junciformis* Engelm. & Gray Pl. Lindl.

628. GLYCERIA NERVATA Trin.: a large form; passing to the next.

629. GLYCERIA PAUCIFLORA Presl, Rel. Hænk. *G. nervata* var. *latifolia* Monro.

630. GLYCERIA FLUITANS R. Brown; slender form with small spikelets.

631. ERAGROSTIS REPTANS Nees; in two or three forms.

632. POA STENANTHA Trin. Probably also *P. leptocoma* Trin. and certainly *Festuca nervosa* Hook. Fl. Bor.-Am. t. 232.

633. POA ANDINA Nutt. herb.; a condensed form with larger spikelets.

634. POA TENUIFOLIA Nutt. in herb.; Watson, Bot. King, p. 387. *Poa melicoides* Nutt. in herb. Durand and herb. Lowell. The proper genus perhaps is *Atropis*, and indeed the present species appears to pass into *Atropis Californica* (or *Schlerochloa Californica*) Munro.

635. MELICA BULBOSA Geyer in Hook. Kew Jour. Bot. (Pl. Geyer.) 8, p. 10. *M. poæoides* Torr. Bot. Whippl., Bolander, &c., non Nutt.* Geyer's name is preferred in the absence of any reason for changing it to *M. Geyeri*, as Munro proposes; especially as the plant described under this name by Bolander is different.†

636. LOPHOCHLÆNA REFRACTA, n. sp. Ab affini *L. Californica* insigniter differt foliis latioribus (lin. 4 latis), racemo virgato, spiculis mox refractis angustioribus fere linearibus, floribus subdissitis, paleis tenuioribus fere lævibus, arista palea ipsa breviore. — An interesting accession to a remarkable genus, which, it seems to me, should stand next to *Melica*. I possess no specimen of "*Melica aristata* Thurber" in Dr. Bolander's revision of the genus: but *Melica Harfordii* of Bolander is evidently an intermediate link.

637. FESTUCA MYURUS L., the *F. bromoides* L. also.

638. FESTUCA MICROSTACHYS Nutt. Pl. Gamb. p. 187. 639. Var.

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* *Melica poæoides* Nutt. Pl. Gamb. p. 188, is described as from Dr. Gambell's collection, and is said to come from the "Island of Santa Catalina," — which Gambell visited, but Nuttall did not. In the distributed set of Gambell's plants acquired by Mr. Lowell, and in that for Mr. Durand (now in my possession), there is no "*Melica poæoides*." There is, however, a "*Poa melicoides*" from "Catalina," which is the same as no. 634 of the present collection, namely, a plant which Nuttall named "Poa tenuifolia."

By the kind aid of Dr. Carruthers, keeper of the herbaria of the British Museum, I am enabled to say that the "*Melica poæoides* Nutt. MSS." of his own herbarium, and apparently of his own collecting, is ticketed "San Diego." But it is pretty clearly the plant described in Pl. Gamb. It differs from the *M. panicoides* of the same paper in having (as described) two perfect flowers in most of the spikelets, while that has commonly only one; but both belong to *Melica imperfecta* Trin.

† *Melica Geyeri* Bolander in Proc. Calif. Acad. 4, p. 102, as represented by no. 40 of his small collection, is very unlike *M. bulbosa* of Geyer's collection. To obviate further confusion, it would be well, and perhaps not too late, for Dr. Bolander to restore to it specifically his appropriate name of *M. bromoides*.

ciliata (*Vulpia* Munro). A little of the var. *divergens* Thurber was also collected. A polymorphous species, which Professor Thurber inclines to unite with the European *F. delicatula* Lag.

640. FESTUCA OCCIDENTALIS Hook. 641. Variety less evolute, approaching *F. duriuscula L.*

642. FESTUCA SCABRELLA Hook. Fl. Bor.-Am. t. 233.

643. FESTUCA OVINA L. var. Dwarf alpine form.

644. BRIZOPYRUM SPICATUM Hook. & Arn. *B. boreale* Presl.

645. BROMUS (SCHEDONORUS) SUBULATUS Griseb. in. Fl. Ross. 2, p. 358. *Festuca subulata* Bongard Veg. Sitka, p. 55; Griseb. l. c. p. 354. Our specimen from Chamisso's collection (Unalaschka) is named "*Festuca acerosa* Trin." A younger form, apparently, also from the St. Petersburg Academy, has a printed ticket, "*Festuca altaica* Trin.: Alaschka." This rare and ambiguous grass seems to belong to *Bromus*, rather than to *Festuca*.

646. BROMUS (CERATOCHLOA) CARINATUS Hook., fide Thurber in litt. I do not find the name. 647, 648. Forms of the same.

649. BROMUS RACEMOSUS L.; a depauperate form, doubtless introduced.

650. TRITICUM REPENS L.: a slender form of it or *T. caninum.*

651. ELYMUS SIBIRICUS L. 652. A form with downy culm and leaves. 653. A slender and smooth variety.

654. ELYMUS SITANION Schult. *Sitanion elymoides* Raf.

655. ELYMUS CONDENSATUS Presl, var. *E. dasystachys* Trin.?

656. HORDEUM PRATENSE Hudson. 657. A glaucous form of it.

658. LOLIUM PERENNE L., var. MULTIFLORUM. *L. multiflorum* Lam. Italian Ray Grass. Doubtless introduced.

659. DANTHONIA SPICATA Beauv. A Californian form with larger spikelets and leaves.

660. DANTHONIA CALIFORNICA Bolander, Proc. Calif. Acad. *D. unispicata* Munro in herb. appears to be a reduced form of this.

661. TRISETUM SUBSPICATUM Beauv., var. MOLLE Gray; a short but very downy form. 662. A tall but almost glabrous form.

663. TRISETUM CERNUUM Trin.; Hook. Fl. Bor.-Am. 2, p. 244.

664. AIRA DANTHONIOIDES Trin. 665. A. ELONGATA Hook. l. c. t. 228. The two seem somewhat too closely allied.

666. AIRA LATIFOLIA Hook. l. c. p. 243, t. 227.

667. AIRA (DESCHAMPSIA) CÆSPITOSA L. A taller and a lower form of the species.

668. ARRHENATHERUM AVENACEUM Beauv. Introduced?

669. HIEROCHLOE MACROPHYLLA Thurber, in Bolander coll.

670. BECKMANNIA ERUCÆFORMIS Host.

671. PANICUM DICHOTOMUM L. var.

672. PANICUM SCOPARIUM Lam., fide Thurber. "This is *P. macrocarpon* Torr. Fl. N. Y., and the *P. pauciflorum* of Gray, Man., but whether of Elliott is very doubtful. A good character is found in the perfect flower, namely a distinct horizontal fold or ridge at the base of the lower palet." Thurber, in litt.

673. POLYPODIUM VULGARE L., var. OCCIDENTALE Hook. Fl. Bor.-Am. 2, p. 258.

674. POLYPODIUM SCOULERI Hook. & Grev. Ic. Fil. t. 56.

675. GYMNOGRAMME TRIANGULARIS Kaulf.; Hook. & Grev. Ic. Fil. t. 153.

676. ADIANTUM PEDATUM L., and, 677, a little A. CHILENSE Kaulf., not before found so far north.

678. PTERIS AQUILINA L., var. LANUGINOSA Hook. Spec. Fil.

679. CRYPTOGRAMME ACROSTICHOIDES R. Br.; Hook. & Grev. Ic. Fil. t. 29.

680. LOMARIA SPICANT Desv. *Blechnum boreale* Swartz? Hook. l. c.

681. ASPLENIUM TRICHOMANES L. Rather larger than the Eastern American form.

682. ASPLENIUM (ATHYRIUM) FILIX-FŒMINA Bernh., mostly with pinnules deeply pinnatifid. 683. Var. MICHAUXII Mettenius; D. C. Eaton in King Expl. p. 396: a remarkable form of the species.

684. PHEGOPTERIS DRYOPTERIS Fée. *Polypodium Dryopteris* L.

685. ASPIDIUM SPINULOSUM Swartz, var. DILATATUM. 686. Another form of the same.

687. ASPIDIUM FILIX-MAS Swartz; the Californian form, namely *A. argutum* Kaulf.

688. ASPIDIUM MUNITUM Kaulf.; a short form. 689. Same with shorter and obtuse pinnæ, imitating *A. Lonchitis*.

690. CRYSTOPTERIS FRAGILIS Bernh. 691. Another form of the same.

692. WOODSIA SCOPULINA D. C. Eaton in Canad. Nat. 1865; Baker, Syn. Fil.

693. ISOËTES NUTTALLII A. Braun, probably not yet published. According to Dr. Engelmann, it is distinguished by the velum entirely covering the sporangium, and by the strongly ridged but slightly tuber-

culate-dotted macrospores. It grows in damp springy soil, not in water, in the Willamette Valley, maturing in August and September.

694. Selaginella rupestris Spring, var. tropica Spring. *S. struthioloides* Presl.

695. Equisetum lævigatum A. Braun; Gray, Man. p. 655.

696. Equisetum limosum L.

697. Marsilia vestita Hook. & Grev. Ic. Fil. t. 159.

698. Azolla Caroliniana Willd. *A. microphylla* Kaulf.

699-701. Nitellæ species, not determined.

The *Musci*, *Hepaticæ*, and *Lichenes* are under examination, and will be separately published.

Six hundred and forty-second Meeting.

March 12, 1872. — Monthly Meeting.

The Corresponding Secretary in the Chair.

Mr. C. S. Pierce made a communication on the photometric measurement of the stars, and exhibited an instrument for this purpose devised by Zöllner.

Mr. Lewis H. Morgan presented the following paper on Australian Kinship; with Appendices, by Rev. Lorimer Fison.

There are five classes of facts, preserved in the institutions of savage and barbarous nations, which are now attracting increasing attention. In connection with inventions and discoveries, they have been the instrumentalities by means of which mankind traversed the successive stages of savagery, of barbarism, and of civilization. When these facts are fully ascertained and compared, and the logical deductions are gathered into definite propositions, the most instructive portion of the ancient experience of mankind will be recovered and utilized.

It seems probable that the advancement of man through the successive stages of savagery and of barbarism was greater in degree than it has been since in the stages of civilization. When the savage had raised himself to a barbarian, and the latter had risen to the pastoral and agricultural conditions, this improved man, although still a barbarian, was further removed from the primitive savage than the philosopher of the present age is above this same barbarian. Be this as it may, the experiences of these several conditions are successive links of a common chain, each of which is necessary to the interpretation of the other. Modern institutions plant their roots in the period of barbarism, into which their germs were transmitted from the previous period of savagism; and the experiences of both conditions, through unnumbered ages, were a necessary prerequisite to their possible realization.

These facts, which, apart from inventions and discoveries, are crystallized in domestic institutions, are so many results of the gradual formation in the mind of man of certain ideas, passions, and aspirations, and of their subsequent development through successive stages of progress. Those holding the most prominent position may be generallized as growths of the particular ideas with which they severally stand connected.

They are the following:—

I. The Growth of the Idea of the Family.
II. The Growth of the Idea of Government.
III. The Growth of the Idea of Articulate Language.
IV. The Growth of Religious Ideas, or of Religions.
V. The Growth of the Idea of Property.

With respect to the first, the facts which preserve and reveal the stages of its growth are embodied in systems of consanguinity and affinity, and in marriage laws.

With respect to the second, the germ of this idea must be sought in the tribal organization, or totemic system, and followed down through the stages of personal government perfect in every band into other forms both personal and national, and lastly national and territorial.

With respect to the third, human speech undoubtedly is a development from the rudest and simplest forms of expression. Gesture language must have preceded articulate language, and if so, thought necessarily preceded speech. In like manner the monosyllabical form preceded the syllabical, as the latter preceded the language of concrete words. Thought also presided over each of these successive stages of progressive development. As a growth from the human brain, it is the most original, unique, and extraordinary of its products.

The fourth subject is environed with such intrinsic difficulties that it will probably never receive a perfectly satisfactory exposition.

And, lastly, the idea of property was slowly formed in the human mind, remaining feeble and nascent through immense periods of time. It required all the experience of the ages of barbarism to nourish and develop the germ, and to prepare the human brain to accept its mastery, and to surrender itself to its powerful influence. Its dominance as a passion marks the epoch of civilization commenced. We must recognize this remarkable passion as the only power able to master the hindrances and overcome the obstructions in the pathway of civilization. Property and civilization are substantially convertible terms. A minute knowledge of the processes of evolution of this idea would constitute in some respects the most extraordinary chapter of the mental history of mankind.

The materials to be presented in this paper tend to illustrate, and are confined to, the state of marriage, of the family, and of the tribal organization among the Australian aborigines.

Systems of consanguinity and the tribal organization as they are now found to exist among savage and barbarous nations are chiefly important from the light they seem to throw upon the growth of the idea of the *family* through successive stages of development. Some of these systems of consanguinity are either primitive or quite near the primitive form, whilst others are in different stages of advancement. They indicate with substantial certainty that the *Communal Family*, founded upon the intermarriage of brothers and sisters, was the first and earliest form of the family in the primitive ages; or, at least, the earliest we are as yet able to recognize. Between this and the *Barbarian Family* (second stage of the family) there was a wide interval. The tribal organization intervened between these forms, and produced the gradual transition from one into the other. It seems to have been the primary object of this organization to break up the intermarriage of brothers and sisters, although the same result was reached among the Australian aborigines by a sexual organization anterior, in the order of time, to the totemic system. Brothers and sisters were necessarily of the same tribe, and marriage between them was permanently abolished by the prohibition of intermarriage in the tribe. The tribal organization tended to inaugurate marriage between single pairs, since it forced individuals to seek wives from other tribes, or to acquire them by negotiation, by purchase, and by capture. This tendency, however, was retarded by the subdivision of the same people into several tribes, which furnished each other with wives; but more especially by a system of regulated cohabitation, running by *conjugal* right (*jura conjugialia*)* through a large circle of related persons.

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* The Romans made a distinction between *connubium*, which related to wedlock, considered as a civil institution, and *conjugium*, which was a mere physical union.

Communal marriage and the communal family continued for ages after the introduction of the totemic system. The latter underwent changes within itself before it reached its ultimate form, some of which it will be the object of this paper to illustrate. There are nations of savages now existing which have been tribally organized in all probability for thousands of years, including their remote ancestry, amongst whom it is still in a transition stage.

The *Patriarchal Family* (third stage of the family) when considered in its highest type* came in with the dawn of civilization. As a form of the family it made but a slight impression upon human affairs, for want of universality. But as an example, as well as the creation of a family with a single male head, it was an advance upon any form before that time known, and heralded by the force of the innovation the advent of the *Civilized Family*, or the family in its fourth stage. It thus leaves but two forms through the immense periods anterior to civilization. When the facts are more fully ascertained, it is probable that several well-marked types both of the communal and of the barbarian family will be discovered and indicated, with perhaps one or more permanent forms between the two. For the present it will facilitate investigation if but the four successive forms above indicated are recognized.

Kinship and consanguinity, as used, are not convertible terms. The former relates to the connection through tribes and classes, while the latter relates to the connection by blood through common descents.

The preceding observations have been made to point out the bearing of the facts about to be presented.

The annexed papers on Australian kinship were furnished to the writer by the Rev. Lorimer Fison, an English missionary now resident in Australia, who received the principal facts from the Rev. W. Ridley, an English clergyman, and another English gentleman, T. E. Lance, Esq., both of whom have spent many years among the Australian aborigines, and enjoyed excellent opportunities for observation. They contain original information of an interesting character, showing a phase of the tribal organization, together with a sexual organization, antecedent to the former in point of time, not hitherto known, except generally, as the writer believes.*

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* Polygamy, restricted in the main to chiefs, yielded a low form of the patriarchal family; but the form intended to be indicated is identified with the pastoral state, and with a limited agricultural subsistence. It presupposes a growth of the idea of government beyond that of chief and followers, or even that of an oligarchy of chiefs, and also a considerable development of the idea of property, with an increased amount as well as stability of subsistence.

We may further observe that the tribal institution was one of the oldest of the human family. Commencing in savagery and traversing the remainder of this period and the whole period of barbarism, it has probably been more influential than any other single institution upon human advancement. The nations of the Aryan and Semitic families were tribally organized in the remote past, lived and progressed under it, and only emerged from it, or laid it aside, when they had reached the commencement of their civilized careers. Property overthrew tribalism. In like manner the nations of the Turanian family were thus organized in the barbarous ages, some of them retaining it to the present day, whilst others have worked out from it into partial civilization. The American aborigines and the nations of Central Africa are still living in the tribal state; and this is true also of the Malayan and Australian families, where they have attained to a condition as far advanced as this organization presupposes. There are Polynesian nations still below the tribal state, amongst whom there is evidence of the intermarriage of brothers and sisters until a comparatively recent period.

Island nations progress much slower than continental. Some of them are still savage, and, if not absolutely stationary, are nearer the primitive condition than any other portion of mankind. At the same time their present state points to an anterior condition as far below it, as all the centuries of their experience, with some degree of continuous progress, necessarily implies. The Australians are savages. Belonging to the Alforan race, they rank below the Malayan, the Polynesian, and the Ganowanian. Their domestic institutions, therefore, must approach the primitive type as nearly as those of any other people. It is for the last-named reason that the facts of their social organization, about to be presented, possess a high degree of importance.

Three memoranda, furnished by Mr. Fison, are hereto annexed, and marked A, B, and C. They have been prepared with so much care and precision that but little can be added to render them more complete. Since, however, they were written at different times, it may prove an advantage to the reader to have them presented in a form uniting the three papers in one, thus giving him the option of the secondary or the original. An organization simple to savages may be embarrassing to ourselves until its principles are mastered; but with a reasonable share of attention it can be intelligently followed to the end.

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* A brief notice of this system is given in McLennan's "Primitive Marriage," p. 118, and also in Tylor's "Early History of Mankind," p. 285.

The form of the tribal organization and of kinship under it to be presented, prevails among that portion of the Australian aborigines who speak the Kamilaroi language. They inhabit the Darling River country north of Sidney. It is also found in other Australian nations.

First. The Kamilaroi people are divided into six tribes, standing with reference to the right of marriage in two divisions, as follows: —

1. Iguana (Duli),
2. Kangaroo (Murriira),*
3. Opossum (Mute),
4. Emu (Dinoun),
5. Bandicoot (Bilba),
6. Blacksnake (Nurai).

Originally the first three tribes were not allowed to intermarry with each other, but were allowed to do so with the other three; and *vice versa*. This restriction is not anomalous, and would not of itself invade the fundamental structure of the tribe.† It is now modified in certain definite particulars, but not carried to the full extent of permitting marriage into any tribe but that of the individual. No person can marry into his or her own tribe. Descent is in the female line, the children following the tribe of the mother. These are the essential characteristics of the tribal organization wheresoever this institution is found; and the Kamilaroi tribe, in its external features, is at once perfect and complete.

Secondly. But there is a further division of the people into eight classes, four of which are male and four female, with a regulation in respect to marriage which changes the nature of the tribe itself, or, rather, demonstrates that the tribal organization is in process of development into its true ultimate form. One only of the four classes of males can marry into one only of the four classes of females. More than this, if the male belongs to one of the first three tribes, the female must belong to one of the opposite three. The first restriction is in opposition to the true ideal of the tribe, because, as will hereafter be seen, a portion only of a tribe is allowed to marry with a portion only of another tribe, demonstrating the proposition before advanced, that the totemic system among the Kamilaroi was in the incipient stages of development.

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* Paddymelon, a species of kangaroo.

† The Seneca-Iroquois are divided into eight tribes, as follows: —

1. Wolf.
2. Bear.
3. Beaver.
4. Turtle.
5. Deer.
6. Snipe.
7. Heron.
8. Hawk.

"Originally, with reference to marriage, the Wolf, Bear, Beaver, and Turtle, being brothers to each other, were not allowed to intermarry. The four opposite tribes, being also brothers to each other, were not allowed to intermarry. Either of the first four tribes, however, could intermarry with either of the last four, the relation between them being that of cousins. . . . . In process of time, however, the rigor of the system was relaxed, until the prohibition was confined to the tribe of the individual. . . . . They can now marry into any tribe but their own." — *League of the Iroquois*, p. 83.

The classes are the following: —

Male.	*Female.*
1. Ippai.	1. Ippata.
2. Kumbo.	2. Buta.
3. Murri.	3. Mata.
4. Kubbi.	4. Kapota.

All the Ippais, of whatever tribe, are brothers to each other; all the Kumbos are the same, and so are the Murris and Kubbis respectively. In like manner, all the Ippatas, of whatever tribe, are sisters to each other; all the Butas are the same, and so are the Matas and Kapotas respectively. In the next place, all the Ippais and Ippatas are brothers and sisters to each other, whether children of the same mother or collateral consanguinei, and in whichever tribe they are found, Kumbo and Buta are the same; and so are Murri and Mata, Kubbi and Kapota, respectively. Mr. Fison, quoting from the letter of Mr. Lance, remarks, "All Ippais are brothers, and all Ippatas are their sisters, and so also with Kubbis and Kapotas. If a Kubbi meets a Kapota whom he has never seen or heard of before, they address each other as brother and sister." The Kamilaroi, therefore, resolve into four great groups or circles of brothers and sisters. This is the first distinctive feature of the Australian system of kinship, disclosing an organization older than the tribes founded upon sex, and more archaic than any constitution of society hitherto discovered.

The term *classes* will perhaps answer for these subdivisions, although not entirely satisfactory. The classification is apparently sub-tribal, but in reality sexual. It has its primary relation to a law of marriage as remarkable as it is original.

Brothers and sisters are not allowed to marry. They are necessarily of the same tribe, except as they are tribal brothers and sisters through the class connection. Therefore the classes stand to each other in a different order with respect to the right of marriage, or the privilege of cohabitation, which better expresses the relation. One class of males, as before stated, can marry but one class of females. Such was the original law, thus:—

Ippai marries Kapota, and no other.
Kumbo “ Mata “ “ “
Murri “ Buta “ “ “
Kubbi “ Ippata “ “ “

This exclusive scheme has been modified in one particular, as will be hereafter shown.

It is thus seen that each male in the selection of a wife, or rather in the range of the conjugal privilege, is limited to one fourth part of all the Kamilaroi females. Ippai, in the Emu, Bandicoot, and Blacksnake tribes, can marry Kapota in the Iguana, Kangaroo, and Opossum tribes; and Kumbo, in the same first three, can marry Mata in the last three. On the other hand, Murri and Kubbi in the last three can marry Buta and Ippata respectively in the first three tribes. This, however, is not the most remarkable part of the system. Theoretically, every Kapota is the wife of every Ippai, every Mata is the wife of every Kumbo, every Buta of every Murri, and every Ippata of every Kubbi. Upon this material point the information communicated by Mr. Lance to Mr. Fison is specific. The latter, after observing that Mr. Lance had “had much intercourse with the natives, having lived among them many years on frontier cattle stations on the Darling River, and in the trans-Darling Country,” quotes from his letter as follows: “If a Kubbi meets a stranger Ippata, they address each other as *Goleer* = Spouse. . . . . A Kubbi thus meeting an Ippai, even though she were of another tribe, would treat her as his wife, and his right to do so would be recognized by her tribe.” (See Memo. B.) *A fortiori* every Ippata within the immediate circle of his acquaintance would also be his wife.

Here we find, in a direct and definite form, communal marriage, or a legalized system of cohabitation in a great communal family, with the family itself as comprehensive as the range of the conjugal privilege. Under these *jura conjugialia* a domestic institution was formed, giving to one quarter of all the males the conjugal privilege with one quarter of all the females of the Kamilaroi nation; and making it the basis, originally, of their social organization. It is but a step from promiscuous intercourse; or the same thing, in reality, with a method. Moreover, it is deeply significant as a revelation of an existing state of marriage, and of the family in a nation of savages. It is the first direct evidence of a condition of society which had previously been deduced from systems of consanguinity and affinity as extremely probable, if not substantially certain.*

Thirdly. Whilst the children remained in the tribe of their mother, they passed into another class of the same tribe. This will be made apparent by the following table: —

	Male.		*Female.*				*Male.*		*Female.*
1.	Ippai	marries	Kapota.	Their	children	are	Murri	and	Mata.
2.	Kumbo	"	Mata.	"	"	"	Kubbi	"	Kapota.
3.	Murri	"	Buta.	"	"	"	Ippai	"	Ippata.
4.	Kubbi	"	Ippata	"	"	"	Kumbo	"	Buta.

If we follow out these descents, we find that in the female line Kapota begets Mata, and Mata, in turn, begets Kapota. It is the same in the male line; for Ippai begets Murri, and Murri, in turn, begets Ippai. Further than this it will be seen, by crossing from one class into another, that the blood of each male and female ancestor passes through each of the classes; thus Ippai begets Murri, Murri begets Ippata, Ippata begets Kumbo, Kumbo begets Kapota, Kapota begets Mata, Mata begets Kubbi, and Kubbi begets Buta.

Fourthly. Out of the preceding statements we have the full constitution of the tribes, with the several classes belonging to each. The classes are in pairs of brothers and sisters, and the tribes themselves are constituted in pairs, as follows: —

	Tribes.		*Male.*		*Female.*		*Male.*		*Female.*
1.	Iguana (Duli)	All are	Murri	and	Mata,	or	Kubbi	and	Kapota.
2.	Emu (Dinoun)	"	Kumbo	"	Buta,	"	Ippai	"	Ippata.
3.	Kangaroo (Murriira)	"	Murri	"	Mata,	"	Kubbi	"	Kapota.
4.	Bandicoot (Bilba)	"	Kumbo	"	Buta,	"	Ippai	"	Ippata.
5.	Opossum (Mute)	"	Murri	"	Mata,	"	Kubbi	"	Kapota.
6.	Blacksnake (Nurai)	"	Kumbo	"	Buta,	"	Ippai	"	Ippata.

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* "Systems of Consanguinity and Affinity of the Human Family, Smithsonian Contributions," Vol. XVII. p. 480 et seq. Mr. John F. McLennan, in "Primitive Marriage," was the first to collect and point out the evidence of promiscuous intercourse, more or less general, amongst barbarous nations. In this remarkable work, which is noteworthy for its originality, logical acuteness, and thoroughness of research, he remarks: "We have examples of general promiscuity, and examples of modified promiscuity, in which, with a pretence of marriage, the woman may bestow her favors upon any one, under certain restrictions as to rank and family." (p. 117.)

The necessary connection of the children with a particular tribe is proven by the law of marriage and descent. Thus Iguana-Mata must marry Kumbo; her children are Kubbi and Kapota, and necessarily Iguana in tribe. Iguana-Kapota must marry Ippai; her children are Murri and Mata, and also Iguana in tribe. In like manner, Emu-Buta must marry Murri; her children are Ippai and Ippata, and Emu in tribe. Emu-Ippata must marry Kubbi; her children are Kumbo and Buta, and also of the Emu tribe. The same is true with respect to marriages in the two remaining pairs of tribes. It will also be seen that each tribe is made up, theoretically, of the descendants, in the female line, of two supposed female ancestors. Why Mata and Kapota are found in the Iguana, Kangaroo, and Opossum, and not in the other tribes, and why Buta and Ippata are found in the Emu, Bandicoot, and Blacksnake, and not in the first three tribes, is not explained, except that it is a part of the constitution of the tribal system as it now exists among the Kamilaroi.

Moreover, as we find that the Iguana, Kangaroo, and Opossum tribes are counterparts of each other in the classes they contain, it follows that they are subdivisions of one original tribe. Precisely the same is true of Emu, Bandicoot, and Blacksnake, in both particulars; thus reducing the six to two original tribes, with marriage in the tribe interdicted. It is further shown by the fact the first three tribes could not intermarry, nor the last three, with each other. The prohibition which prevented intermarriage when either three tribes was one would follow the subdivisions, who were of the same descent, though under different tribal names. Exactly the same thing is found among the Seneca-Iroquois. If we did not know, from tradition, that the Bear and the Deer were the original tribes, and that the Bear became subdivided into the Wolf, Bear, Beaver, and Turtle, and the Deer into the Deer, Snipe, Heron, and Hawk, we should infer, that the first and the second four respectively were subdivisions of one original tribe, from the single fact that anciently neither of the first four tribes were allowed to intermarry, nor either of the last four. It was for the same reason. They were known to be of the same descent, although under four independent tribal names, and consequently the prohibition continued to assert itself after the separation. In the course of time, as the autonomy of the tribe became complete, this restriction was removed, just as it is now in process of removal among the Kamilaroi, as will presently be shown.

A tribe is not a group or horde occupying a particular territory, but a circle of consanguinei; the fact of consanguinity being preserved by the tribal name. They are mingled in the same family, since husband and wife are necessarily of different tribes. The Kamilaroi tribe would consist of two supposed female ancestors and their children, and all their descendants in the female line in a continuous series. It would include the two mothers and their children, and all the children of their lineal female descendants; the children of the females only belonging to the tribe, whilst the children of the males would belong to the tribes of their respective mothers. The tribe is also the unit of organization in the political as well as, social system of barbarous and savage nations. Among the Kamilaroi there was an antecedent and still powerful organization upon the basis of sex, which might well claim this fundamental position. It afterwards became enfolded in the tribal organization, with the principles of which, when fully developed, it would stand in antagonism. The two organizations could not, at one and the same time, occupy the starting-point of a social and political system. One must give way. It will become apparent in the sequel that the tribal organization is gradually subverting the classes among the Kamilaroi.

Fifthly. Marriage also was restricted to particular classes, as we have seen. Consequently, when there were but two tribes, one half of all the females of one tribe were the wives of one half of all the males of the other tribe. After the subdivision of the two original tribes into six, the benefit of marrying out of the tribe, which was the chief advantage of the tribal organization, was arrested, if not substantially neutralized, by the restrictions mentioned. It resulted in continuous in-and-in marriages, without the near degree of own brother and sister. There are but four descents in Kamilaroi kinship, because there are but four supposed female ancestors from whom all the people are descended. Mata and Kapota, who are found in Iguana, Kangaroo, and Opossum, must marry into Emu, Bandicoot, and Blacksnake; and Buta and Ippata, who are found in the last three, must marry into the first three. Thus two entire tribes are excluded in marriage from each tribe, as well as one half of the remaining tribe. This was the original law of marriage; but it has since been relaxed, as will be elsewhere explained.

If a diagram of descents is made of the descendants of Ippai and Kapota, for example, and carried to the fifth generation, giving to each intermediate pair two children, a male and a female, the following results will appear. The children of Ippai and Kapota are Murri and Mata. As brothers and sisters they cannot marry. At the second degree the children of Murri married to Buta are Ippai and Ippata, and of Mata married to Kumbo are Kubbi and Kapota. Of these Ippai marries his cousin Kapota, and Kubbi marries his cousin Ippata. It will be noticed that the eighth class are reproduced from the original pair in the second and third generations. In the next, or third degree, there are two Murris, two Matas, two Kumbos, and two Butas; of whom the Murris marry the Butas, their second cousins, and the Kubbis the Matas, also their second cousins. At the fourth generation there are four each of Ippais, Kapotas, Kubbis, and Ippatas, who are third cousins. Of these the Ippais marry the Kapotas, as before, and the Kubbis the Ippatas. At the fifth generation there are eight each of Murris and Butas, Kumbos and Matas. They are fourth cousins, of whom the Murris marry the Butas, and the Kumbos the Matas. A similar chart of the other marriageable classes will produce like results. It is thus made apparent that near consanguinei not only intermarry constantly, but are compelled to do so by this sexual organization. One of the primary objects secured by the tribal organization, when fully developed, so as to allow marriage into every tribe but that of the individual, was thus defeated.

Sixthly. We come next to an innovation upon the original constitution of the tribes, which reveals a movement, still pending, in the direction of the true ideal of the tribe. It is shown in two distinct particulars: First, in allowing the first three and the second three tribes respectively to intermarry to a limited extent; and, secondly, to marry into classes not before permitted. Thus Iguana-Murri can now marry Mata in the Kangaroo tribe, his sister; whereas originally he was restricted to Buta, in the opposite three tribes. So Iguana-Kubbi can now marry Kapota, his sister, in the Kangaroo tribe, whereas he was at first restricted to Ippata, in the opposite three tribes. In like manner Emu-Kumbo can now marry Buta, his sister, in the Blacksnake tribe, and Emu-Ippai can marry Ippata, his sister, in the same tribe, contrary to original limitations. Each class of males in each of the three tribes seems now to be allowed one additional class of females in the two remaining tribes, from which they were before excluded. Mr. Fison, however, in his table (Memo. C), does not show a change to the full extent here indicated.

This innovation would have been a retrogade movement, but that it tended to break down the classes, and thus give to every male the right to marry any female in any tribe but his own, which, we have seen, is the law of the tribal organization in its ultimate form. When in its final stage it necessarily assures a greatly increased tendency to marriage between single pairs, leading to the establishment of the barbarian family, with a great curtailment of the range of the conjugal privilege. The line of progress among the Kamilaroi was evidently from classes into tribes, followed by a tendency to overthrow the classes, and to render the tribe, instead of the class, the unit of organization. In this movement the overshadowing system of cohabitation was the resisting element. It is the first instance in which we have been able to look far down into the incipient stages of the tribal organization, and even through it upon an anterior condition so truly archaic as an organization of society upon sex. It seems to afford a glimpse at the absolutely primitive state of man. The tribe, as it progressed toward its ultimate form, seems to have advanced, *æquo pede*, with the curtailment of the range of the conjugal privilege, which, among the Kamilaroi, still verges upon promiscuity. The inference is plain, that ages upon ages passed away whilst the tribal organization, even among the most highly endowed races, was passing through its successive phases. Among the Australian aborigines it is still in a rudimentary state, although possessing the more prominent characteristics. They might not have effected the overthrow of the classes for thousands of years to come, had they remained undiscovered and undisturbed in their insular homes; whilst more favored continental nations, commencing in a similar condition, have first advanced this organization through its successive stages, and then worked their way out from it into civilization. It seems probable that the tribes among the Fijians and Micronesian Islanders, where the totemic system is known to exist, will be found in the same transitional stage. The innovations described were clearly in the nature of reformatory movements to reduce the excessive amount of in-and-in marriage among consanguinei. Facts such as these illustrating the successive stages of development of the tribal organization are of the highest importance and of peculiar value. Marriage and the family are involved at every stage of this progress, and the growth of the idea of each must be traced through all the shades of man's experience in the tribal state, before the conception of the barbarian family is reached, which is then but the family in its second stage.

It must be admitted that the Kamilaroi classes are older than the tribes. They resolve the people into groups of brothers and sisters; and by a second grouping, with respect to marriage, a conjugal system was established but little short of promiscuity. The resulting family was communal, and coextensive with the range of the privileges, but broken up into smaller communal families consisting of such persons as were immediately associated for mutual protection and subsistence. The classes, founded upon sex, the first and most obvious division of the species, was perhaps the germ of the tribe founded upon consanguinity. The true family, resting upon marriage between one man and one woman, with an exclusive cohabitation, was neither conceivable nor attainable in savage life. Man was still perceptibly gregarious, with an irresistible tendency toward communism in wives and in living, but, under the teachings of experience, with some measure of restriction as to numbers of the former.

This division into male and female classes, with a prohibition of the intermarriage of brothers and sisters, shows plainly enough that such marriages were common anterior to the establishment of the classes, and that the classes owe their origin to a desire to break up the practice. The tribal organization embodies the same prohibition as its central idea; whence the inference from each source that such marriages were normal in the previous period. Moreover, the classes did not look beyond this result; for we have seen that it compels in-and-in marriages beyond this degree by positive institution. If any doubt could rest upon this question, it is entirely removed by the Malayan system of consanguinity, which is decisive and in point.*

When the two original tribes came in over the classes, with the progress of experience, no substantial change was effected in the previous condition. The subsequent division of these tribes into six, with the maintenance of the same law of marriage and descents, left the social condition essentially the same; except, by retaining larger numbers of people under a common tribal system, it brought persons more distantly connected into the marriage relation. This was a beneficial tendency. The next movement was more important, namely, allowing the tribes which were subdivisions of an original one, to marry into each other. Although tribally brothers and sisters, they had been separating in degree through as many centuries as had elapsed since their division, except as their blood had intermingled through common descents. In the next place, by allowing the males to marry into two classes of females, instead of one, a still greater advance was made, and of a radical character. These changes must be regarded as reformatory movements tending to the realization of the true ideal of the tribe, in which, as elsewhere stated, a man can marry a woman of any tribe but his own, and also of any foreign nation. The Kamilaroi tribal system is below this final stage. Beside this, it still retains a conjugal system more stupendous and extraordinary than any hitherto found in any nation of barbarians, or in any other nation of savages.

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* Systems of Consanguinity and Affinity of the Human Family, pp. 454, 482.

The social state of the Kamilaroi, with the classes in full vigor, but enveloped in a tribal organization progressing gradually to their overthrow, seems much nearer the primitive constitution of society than any organized form previously known. It has, in all probability, remained in this condition substantially for centuries, the changes above indicated representing the whole amount since the tribal idea was developed. It does not follow that this form of the system was indigenous in Australia, since it may have been carried, with their remote island ancestors, from a primitive Asiatic seat, and maintained, with slight changes, through the intermediate periods of time. The antiquity of the tribal organization is without known limits. It is, at least, coeval in its germ with the time when brothers and sisters ceased to intermarry. The hypothesis of its propagation from an original centre into all the families of mankind is much more in harmony with ascertained facts than any other, looking to its spontaneous or indigenous development in many different places and in different ages. Original ideas, absolutely independent of previous knowledge and experience, are necessarily few in number, and as rare as original germs of animal life. Were it possible to reduce the present sum of human ideas to underived originals, the numerical result would be startling. Human experience has run in such uniform channels as to suggest the presence of a governing element incorporated in the original constitution of man, which predetermined the direction and limits of this experience. This argument leads to an original man; and to his development, through growth and specific reproduction, which necessarily must have been progressive, logical, and homogeneous. The tribal organization seems to have sprung from this class of primary conceptions.

The barbarian family, which has been frequently named, is more easily characterized than defined. Its nucleus was a pair, of which the man regarded the woman as his principal wife, and the woman the man as her principal husband, but without an exclusive cohabitation. Associated with them for mutual subsistence and protection were other similar pairs, living with their children in a common household, with a restricted but not prohibited cohabitation. The barbarian family, as it now exists in the Ganowanian family, approaches the civilized family. It is founded upon marriage between single pairs, with fragmentary families of near kindred united in a common household; but with the conjugal privilege above indicated either extinct, or reduced to narrow limits. At the time of their discovery the more advanced were living in large communal houses, and practising communism in living as far as the same could be carried out in practical life. Conjugal fidelity was exacted of the women, but not of the men. Where a man can put away his wife at pleasure, as he may in most barbarous nations, and always could among the old Romans, continence is not the highest virtue.*

Mr. Fison in Memorandum A has deduced theoretically the Turanian system of consanguinity from Kamilaroi kinship. It is both ingenious and interesting, and fully sustained by the principles of the tribal system. The actual system, when procured, will probably agree with the theoretical substantially, but fall below it in some particulars. Mr. Fison furnished schedules of consanguinity and affinity of the Yarras, near Melbourne, and of the Murray bands near Victoria, but neither is sufficiently perfect to establish the exact character of the system. It is partly Malayan, but chiefly Turanian in form, and evidently in the transition stage from one into the other. This was to have been expected from the condition of the tribal organization among the Kamilaroi, and which is presumptively in the same stage among the Yarras and Murray bands.

It is perhaps unnecessary to remark that the Kamilaroi people have each a personal name to distinguish the individual. When we say Ippai marries Kapota, we simply mean that a male of the Ippai class marries a female of the Kapota class.†

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* The American Indians describe *divorce,* "throwing a woman away"; thus adding contempt to injury. The Romans divorced their wives of their own volition; but the right was subject to the obligation of restoring the dower of the wife. Ovid, as we know, put away two wives, and Cicero two. *Divortium,* whence divorce, originally related to the putting away of a wife exclusively.

† Savages seem to have a tendency to classify persons into groups. The tribes of the Maranoa district, Queensland, who speak the Unghi dialect, divide the males into classes according to age. Up to seventeen or eighteen years of age a male is

In the light of this discussion some of the excrescences of modern civilization, such as free love and Mormonism, are seen to be relics of the old savagism not yet eradicated from the human brain. The nations of the Aryan family assume not only to be civilized, but to be far advanced in civilization; whereas this is strictly true of a small minority only. Barbarism and savagism still lurk in all cities, and in all corners of civilized lands, repressed by law and restrained by superior intelligence. We have the same identical brain, perpetuated through reproduction, which worked in the skulls of savages and barbarians in bygone ages; and it has come down to us ladened and saturated with the thoughts, aspirations, and passions with which it was busied through the intermediate periods. It is the same brain grown older and larger with the experience of the ages. These outcrops of barbarism are so many revelations of its anterior proclivities; a kind of mental atavism.

Finally, out of a few germs of thought, planted in the human brain in the primitive ages, have been evolved all the institutions of mankind. Beginning their growth in the period of savagery, fermenting through the period of barbarism, they have reached their fruition in the period of civilization. The evolution of these germs of thought was guided by a natural logic, which formed an essential attribute of the brain itself. So unerringly does this principle perform its functions in all conditions of experience, and in all periods of time, that its results are uniform, coherent, and traceable in their courses. These results alone will in time yield convincing proofs of the unity of origin of the human family. The mental history of mankind, which is crystallized in civil and domestic institutions, and in inventions and discoveries, is presumptively the history of a single species, perpetuated through individuals, and developed through experience. Among the original germs of thought, as stated at the outset, which have exercised the most powerful influence upon the human mind, and upon human destiny, are those which relate to the *family*, to *government*, to *language*, to *religion*, and to *property*. They had a definite beginning, a logical progress, but can have no final consummation, because they are still progressing, and must ever progress.

Andoo; from eighteen to about thirty he is Howalah, and is allowed to marry; from thirty to about fifty he is Muidara, and after fifty he is Ngara. Beside this they have the class divisions of the Kamilaroi, and the tribes. This information was communicated to Mr. Fison by Mr. A. S. P. Cameron.

APPENDICES.

AUSTRALIAN ABORIGINES. By REV. LORIMER FISON.

Memorandum A.

The Rev. W. Ridley, M. A., Presbyterian clergyman, who has spent many years among the Australian aborigines, kindly wrote a short paper for me on a "comprehensive social classification," which he had found among those savages. "The same system," he observes, "with the same names, prevails among tribes speaking different dialects; and even where different names are used, the same system substantially exists."

Among the tribes speaking the Kamilaroi language, all the men bear one of these four names, —

Ippai.	Murri.	Kubbi.	Kumbo.

All the women bear one of these,—

Ippata.	Mata.	Kapota.	Buta.

There are certain rules of marriage and descent, which for convenience of reference I arrange as follows: —

	A.					B.		
	Male.		*Female.*			*Male.*		*Female.*
1.	Ippai	marries	Kapota.	Their children are:	1.	Murri	and	Mata.
2.	Murri	"	Buta.	" " "	2.	Ippai	"	Ippata.
3.	Kubbi	"	Ippata.	" " "	3.	Kumbo	"	Buta.
4.	Kumbo	"	Mata.	" " "	4.	Kubbi	"	Kapota.

These rules of marriage do not forbid polygamy. Thus Kumbo may have as many Matas as he likes, but he may not have Ippata, Buta, or Kapota. So also with all the other names excepting Ippai, who has the privilege of cohabiting with Ippata as well as Kapota. This, however, Mr. Ridley considers to be "an infringement of rule, allowed in favor of some powerful Ippai, and so continued." It seems evident that this must be so; and it is worthy of remark that the children of Ippai and Ippata are Kumbo and Buta, as also are the children of Kubbi and Ippata.

Among tribes not speaking Kamilaroi, the following names are used: —

1. Urgilla.	2. Wunggo.	3. Obŭr.	4. Maburri	(male).
1. Urgillagun.	2. Wungooun.	3. Oburgun.	4. Maburrigun	(female).

These are in the Balomer language.

Among the Moreton Bay aborigines the names in use are for the males Derwain, Bandŭr, Barang, Bundŭr, with the additional syllable *gun* or *un* for the females.

At Wide Bay five names are in use, namely, —

Bundar. Derwain. Balkoin. Tandor. Barang.

But it is not clear from Mr. Ridley's paper whether these names are written in their proper order; nor are we informed whether any two of them are common to one class. If they be all distinct from one another, there must be a fifth class.

This is the substance of the information supplied to me by Mr. Ridley.

NOTE. — Reasoning from the analysis furnished by the systems prevailing among other savage races, which systems have been thoroughly examined and ascertained, we may fairly conclude that the various names given in Mr. Ridley's paper are classificatory, and that they represent certain degrees of kinship. Thus, that

Kubbi is in theory the brother of every Kubbi of the same generation.
Kapota " " sister " " Kubbi " " "

Taking this for granted, and ignoring for the present the privilege granted to Ippai of marrying Ippata as well as Kapota, — the variations caused thereby being kept for subsequent investigation, — the characteristic peculiarities of the Tamilian system, which is the Fijian also, are proved to exist among the Australian aborigines.

For the sake of convenience, I state these characteristics as seven different propositions.

I. *Tamilian Characteristic.*[*]

I being male, the children of my brothers are my sons and daughters, while the children of my sisters are my nephews and nieces; but the grandchildren of my sisters, as well as those of my brothers, are my grandchildren.

This is so in the Australian system also.

For, take any male Kubbi.

(a) I, being male, am Kubbi. My brother is Kubbi.
His son is Kumbo (B. 2).
But Kumbo is my son (B. 3).

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[*] For an exposition of the Tamilian system, see Proc. Am. Acad., Feb., 1868, p. 436.

Therefore my brother's son is my son.

So also it may be shown that his daughter is my daughter.

(b) My sister is Kapata (B. 4). Her son is Murri (B. 1).

But Murri is not my son, for my son is Kumbo (B. 3).

Therefore my sister's son is my nephew, this being the only other relationship possible.

So also it may be shown that my sister's daughter is my niece.

(c) My grandsons are Kubbi, son of my son Kumbo (B. 4).
and Ippai " " daughter Buta (B. 2).

My sister's (Kapota's) grandsons are Ippai, son of her son Murri (B. 2); and Kubbi, the son of her daughter Mata (B. 4).

But Ippai and Kubbi, as already shown, are my grandsons. In like manner it may be shown that her granddaughters are my granddaughters.

Therefore my sister's grandchildren are my grandchildren.

II. *Tamilian Characteristic.*

I, being female, the children of my sisters are my sons and daughters, while the children of my brothers are my nephews and nieces; but the grandchildren of my brothers, as well as those of my sisters, are my grandchildren.

In the Australian system, take any female Kapota.

(a) I, being female, am Kapota. My sister is Kapota.

Her son is Murri (B. 1). But Murri is my son (B. 1).

Therefore my sister's son is my son. So also his daughter is my daughter.

(b) My brother is Kubbi (B. 4). His son is Kumbo (B. 3).

But Kumbo is not my son, for my son is Murri (B. 1).

Therefore (as in B. 1) my brother's son is my nephew.

So also his daughter is my niece.

(c) My brother Kubbi's grandsons are Kubbi and Ippai (see I. c).

But Ippai and Kubbi are my grandsons (see I. c).

Therefore my brother's grandsons are my grandsons.

So also his granddaughters are my granddaughters.

III. *Tamilian Characteristic.*

All my father's brothers are my fathers, but all my father's sisters are my aunts.

(a) I being Kubbi or Kapota, i. e. male or female, my father's brother is Kumbo. But Kumbo is my father (A. 4).
Therefore my father's brother is my father.

(b) My father's (Kumbo's) sister is Buta (B. 2). But Buta is not my mother, for my mother is Mata (A. 4).
Therefore, no other relationship being possible, my father's sister is my aunt.

IV. *Tamilian Characteristic.*

All my mother's sisters are my mothers, but all my mother's brothers are my uncles.

In the Australian system, I being Kubbi or Kapota (i. e. male or female), my mother's sister is Mata.

(a) But Mata is my mother (A. 4).
Therefore my mother's sister is my mother.

(b) My mother's brother is Murri (B. 1).
But Murri is not my father, for my father is Kumbo (A. 4).
Therefore my mother's brother is my uncle.

V. *Tamilian Characteristic.*

The children of my father's brothers, and those of my mother's sisters, are my brothers and sisters; but the children of my father's sisters, and those of my mother's brothers, are my cousins.

In the Australian system, I being Kubbi, a male.

(a) My father's brother is Kumbo.
My father's brother's (Kumbo's) son is Kubbi (B. 4).
But every Kubbi is my brother, for I also am Kubbi.
Therefore, my father's brother's son is my brother.
So also it may be shown that my mother's sister's son is my brother, and that her daughter (as also my father's brother's daughter) is my sister.

(b) My father's (Kumbo's) sister is Buta (B. 3).
Her son is Ippai (B. 2).
But Ippai is not my brother, for my brother is Kubbi.
Therefore my father's sister's son is my cousin.
So also it may be shown that my mother's brother's son is my cousin, and that her daughter (as also my father's sister's daughter) is my cousin.

VI. *Tamilian Characteristic.*

I, being male, the children of my male cousins are my nephews and nieces, but the children of my female cousins are my sons and daughters.

In the Australian system, I being Kubbi, a male.

(a) My male cousins are Ippai, son of my father's sister Buta (B. 2).
and Ippai, son of my mother's brother Murri (B. 2).
Ippai's children are Murri and Mata.
But Murri and Mata are my nephews and nieces (I. b).
Therefore the children of my male cousins are my nephews and nieces.

(b) My female cousin is Ippata, daughter of my father's sister Buta (B. 2).
and Ippata, daughter of my mother's brother Murri (B. 2).
Ippata's children are Kumbo and Buta.
But Kumbo and Buta are my children (B. 3).
Therefore the children of my female cousins are my sons and daughters.

VII. *Tamilian Characteristic.*

All the brothers of my grandfathers and those of my grandmothers are my grandfathers; all their sisters are my grandmothers.

In the Australian system, I being Kubbi or Kapota (i. e. male or female), my grandfathers are

Kubbi, the father of my father Kumbo (A. 3), and
Ippai " " " mother Mata (A. 1).
But all my grandfather's brothers are either Kubbi or Ippai.
Therefore they are my grandfathers.
My grandmothers are Ippata, mother of my father Kumbo (A. 3).
and Kapota, " " mother Mata (A. 1).
Ippata's brother is Ippai; Kapota's brother is Kubbi.
But Ippai and Kubbi are my grandfathers.
Therefore my grandfather's brothers are my grandfathers.
Again, my grandmother's sisters are either Ippata or Kapota.
But Ippata and Kapota are my grandmothers.
Therefore my grandmother's sisters are my grandmothers.

As for the complications caused by the intermarriage of Ippai and

Ippata, further information will doubtless make them easier of explanation.

From Tables A and B it will be seen: —

That Kubbi's cousins are Ippai and Ippata of the same generation.
Kumbo's " " Murri " Mata " " "
Ippai's " " Kubbi " Kapota " " "
Murri's " " Kumbo " Buta " " "

Hence (from Table A) a man must marry his female cousin.

Kubbi may not have his male cousin Ippai's wife, for she is Kapota, his sister (A 1).
Kumbo " " " Murri's " " Buta, " (A 2).
Ippai " " " Kubbi's " " Ippata " (A 3).
Murri " " " Kumbo's " " Mata " (A 4)

Hence a man is allowed his female cousins, but the wives of his male cousins were forbidden to him. Thus it is also with the Fijian system, and the Tamilian, as I pointed out in Memorandum No. 4; and this explains the difference between these systems and that of the Seneca-Iroquois as to the relationships between a man and the children of his cousins, male and female.

SYDNEY, May 1, 1871.

Memorandum B.

AUSTRALIAN ABORIGINES.

T. E. Lance, Esq. (of Bungowalbyn, Lawrence, Clarence River, N. S. W.), has favored me with an extremely interesting letter, which fully confirms, not only the information given me by the Rev. W. Ridley, but the conclusions also which I drew from that information. (See Memo. A.)

Mr. Lance has had much intercourse with the natives, having lived among them for many years on frontier cattle stations on the Darling River, and in the Trans-Darling country.

1. He says: "All Kubbis are brothers, and all Kapotas are their sisters: and so also with the Ippais and Ippatas." (See Table B. Memo. A.)

2. "If a Kubbi meets a Kapota whom he has never seen or heard of before, they address each other as brother and sister. If he meets a strange Ippata, they address each other as *goleer* = spouse."

Hence we may infer that these nations salute by the title of kinship as do the Fijians also.

3. He informs me "that a Kubbi thus meeting an Ippata, even though she were of another tribe, would treat her as his wife, and that his right to do so would be recognized by her tribe."

Inference: The word *goleer* = wife, as the Fijian *wate* = wife, does not imply the conjugal relation as understood by us, but is simply "one of those with whom I may cohabit."

4. Mr. Lance, after telling me about the class-names and their various relations, goes on to say: "The way I have stated as between the different names is the normal and usual regulation; but it is crossed and complicated occasionally by other arrangements which I do not understand."

Probably these complications are caused by the privilege granted to Ippai of taking Ippata as well as Kapota, which Mr. Lance seems not to have noticed.

5. He says: "Every black fellow, besides the names I have mentioned (i. e. the class-names), is called after some animal, which he calls his *Mudgee*, implying some incomprehensible relationship. The usual rule is that every Kumbo is an Emu, every Ippai a Blacksnake, every Kubbi an Iguana, etc. They have also a third individualizing name. But sometimes I have come across a man and wife whose names were not suitable for the connection; and on inquiring how this could be, they would reply, 'This Ippai is not a Blacksnake, as are most Ippais, but an Opossum. That explains it.'"

This appears to me to be important. The "names not suitable for the connection" must be the class-names borne by the couple whom Mr. Lance questioned; and as the man was an Ippai, the woman was probably an Ippata, for had she been a Kapota there would have been nothing strange in the connection (see Table A, Memo. A). Here we have a clew to Ippai's privilege. It seems probable that the Ippais are divided into two classes, the Blacksnakes and the Opossums.

Ippai the Blacksnake being the husband of Kapota; and
Ippai the Opossum being the husband of Ippata.

But I have no information as to whether the Blacksnake may be the husband of Ippata, and the Opossum the husband of Kapota. If the Blacksnake be restricted to Kapotas, and the Opossums to Ippatas, we have in effect a fifth class of males. Now the Rev. W. Ridley informs me that among the Wide Bay natives, five class-names for males are used (see Memo. A). Further inquiries as to the Wide Bay names will probably throw further light on this point.

SYDNEY, May 5, 1871.

Memorandum C.

AUSTRALIAN ABORIGINES.

N. B. Duli = Iguana. Murriira = Paddymelon, a sort of Kangaroo.
Dinoun = Emu. Nurai = Blacksnake.
Bilba = Bandicoot. Mute = Opossum.

The Rev. W. Ridley, M. A., who has recently returned from a visit to the interior, during which he kindly made further inquiries for me as to the class-names, now informs me that the divisions indicated by these class-names are further subdivided as follows: —

CLASS-NAMES.	SUBDIVISIONS.		
1. Murri and Mata.	1. Duli.	2. Murriira.	[3. Mute.] *
2. Kumbo and Buta.	1. Dinoun.	2. Nurai.	[3. Bilba.] *
3. Ippai and Ippata.	1. Dinoun.	2. Nurai.	3. Bilba.
4. Kubbi and Kapota.	1. Mute.	2. Murriira.	3. Duli.

That is, the Murris are subdivided into two classes, Murri-Duli and Murri-Murriira. So also with the other names.

LAWS OF MARRIAGE.

1. Murri-Iguana † marries any Buta; also Mata-Kangaroo.‡
2. " -Kangaroo " " " " " -Iguana.
3. Kumbo-Emu " " Mata; " Buta-Blacksnake.
4. " -Blacksnake " " " " " -Emu.
5. Ippai-Emu " " Kapota-Kangaroo and Iguana; also Ippata-Blacksnake
6. " -Blacksnake " " " -Opossum " " -Emu.
7. " -Bandicoot " " " -Kangaroo " " -Blacksnake.
8. Kubbi-Opossum " " Ippata-Emu; also Kapoto-Iguana.
9. " -Kangaroo " " " -Blacksnake; " "
10. " -Iguana " " " -Bandicoot " -Kangaroo.

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* I have added these tribes because Murri and Mata are necessarily found in the one and Kumbo and Buta in the other. Mr. Fison does the same elsewhere. — L. H. M.

† I have substituted the English for the native name of the tribes. — L. H. M.

‡ It is important to remember that the children take the mother's second or "animal" name. Also that they take the class-name which is given to the children of their mother by her *proper* husband, — that is, by her husband according to the laws given in Memo. A. Thus, the children of Ippai and Ippata are Kumbo and Buta, as also are the children of Ippata by her proper husband, Kubbi.

There seems to be some little uncertainty about the pronunciation of the class

Hence I deduce the following

LAWS OF DESCENT.

	The Children of	Are Male.	Female.	Memo. A.
1	Murri-Iguana and Buta-Emu	Ippai-Emu	Ippata-Emu	2
2	“ “ “ “ -Blacksnake	Ippai-Blacksnake	Ippata-Blacksnake	2
3	“ “ “ Mata-Kangaroo	Kubbi-Kangaroo	Kapota-Kangaroo	4
4	Murri-Kangaroo and Buta-Emu	Ippai-Emu	Ippata-Emu	2
5	“ “ “ “ -Blacksnake	Ippai-Blacksnake	Ippata-Blacksnake	2
6	“ “ “ Mata-Iguana	Kubbi-Iguana	Kapota-Iguana	4
7	Kumbo-Emu “ “ -Iguana	Kubbi-Iguana	Kapota-Iguana	4
8	“ “ “ “ -Kangaroo	Kubbi-Kangaroo	Kapota-Kangaroo	4
9	“ “ “ Buta-Blacksnake	Ippai-Blacksnake	Ippata-Blacksnake	2
10	Kumbo-Blacksnake and Mata-Iguana	Kubbi-Iguana	Kapota-Iguana	4
11	“ “ “ “ -Kangaroo	Kubbi-Kangaroo	Kapota-Kangaroo	4
12	“ “ “ Buta-Emu	Ippai-Emu	Ippata-Emu	2
13	Ippai-Emu and Kapota-Iguana	Murri-Iguana	Mata-Iguana	1
14	“ “ “ “ -Blacksnake	Murri-Blacksnake	Mata-Blacksnake	1
15	“ “ “ Ippata-Blacksnake	Kumbo-Blacksnake	Buta-Blacksnake	3
16	Ippai-Blacksnake and Kapota-Opossum	Murri-Opossum	Mata-Opossum	1
17	“ “ “ Ippata-Emu	Kumbo-Emu	Buta-Emu	3
18	“ Bandicoot and Kapota-Kangaroo	Murri-Kangaroo	Mata-Kangaroo	1
19	“ “ “ Ippata-Blacksnake	Kumbo-Blacksnake	Buta-Blacksnake	3
20	Kubbi-Opossum and Ippata-Emu	Kumbo-Emu	Buta-Emu	3
21	“ “ “ Kapota-Iguana	Murri-Iguana	Mata-Iguana	1
22	“ Kangaroo and Ippata-Blacksnake	Kumbo-Blacksnake	Buta-Blacksnake	3
23	“ “ “ Kapota-Iguana	Murri-Iguana	Mata-Iguana	1
24	“ -Iguana and Ippata-Bandicoot	Kumbo-Bandicoot	Buta-Bandicoot	3
25	“ “ “ Kapota-Kangaroo	Murri-Kangaroo	Mata-Kangaroo	1

The rule, that the children take the mother's second name, gives us two instances of names not recorded in Mr. Ridley's list of the subdivisions, namely, sixteen Murri and Mata-Opossum, and twenty-four Kumbo and Buta-Bandicoot. There must be something wanting here, as we find no provision for the “privileged” marriage of these names.

I think we may take it for granted that there is a third subdivision of all the classes, as follows: —

1. Murri and Mata subdivide into 1. Iguana. 2. Kangaroo. 3. Opossum.
2. Kumbo and Buta “ “ 1. Emu. 2. Blacksnake. 3. Bandicoot.

For, since there are Ippai-Bandicoot and Ippata-Bandicoot, the mother of the two, that is, Buta, must also be Bandicoot, because the children take the mother's second, or tribal name. And, there being a Buta-Bandicoot, there must also be a Kumbo-Bandicoot, because each of all these pairs takes the same second name for both male and female. So also with Murri and Mata-Opossum.

Hence we get six classes, each containing *four names*, consisting of two pairs of brothers and sisters.

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names. Mr. Ridley tells me that some of the natives whom he questioned pronounced Kapota, Kubbotha; Mata, Matha, etc. I retain Kapota for uniformity's sake.

1. Emu (Dinoun)	Ippai and Ippata:	Kumbo and Buta.
2. Iguana (Duli)	Murri " Mata:	Kubbi " Kapota.
3. Kangaroo (Murriira)	Murri " Mata:	Kubbi " Kapota.
4. Blacksnake (Nuari)	Ippai " Ippata:	Kumbo " Buta.
5. Opossum (Muta)	Murri " Mata:	Kubbi " Kapota.
6. Bandicoot (Bilba)	Ippai " Ippata:	Kumbo " Buta.

INFERENCES.

1. From these tables it is evident that a man may cohabit with his half-sister by the father's side, though not with his full sister, or with the half-sister by the mother's side. That this is an innovation on the system explained in Memo. A may perhaps be inferred from the fact that the children of such a connection take the class-names which they would have had, had their father's been of the usual class.

2. Persons having the same animal name may not intermarry.

3. In the six classes arranged under the animal names, it is worthy of note that the names of one pair are those of the children of the woman of the other pair. Thus the Emus are Ippai and Ippata, Kumbo and Buta. Now Ippata is the mother of Kumbo and Buta; and Buta is the mother of Ippai and Ippata (see Laws of Descent, Memo. C).

Mr. Ridley informs me that *Murri* has a third distinguishing name, which is that of his father's grave (see Memo. B).

He also gives me another most important fact, namely, that there are separate terms for brother or sister according to seniority. Thus: —

Daiadi, Elder Brother.	Boadi, Elder Sister.
Gullami, Younger Brother.	Burri, Younger Sister.

These are the words used by a male.

SYDNEY, August 7, 1871.

NOTE. — If the divisions caused by the animal names be tribal, then is it evident that the child is of the mother's tribe, as among the North American Indians and the tribes of Central Africa, because the child always takes the mother's animal name.

Six hundred and forty-third Meeting.

April 9, 1872. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President announced the death of Professor Trendelenberg, Foreign Honorary Member; of Mr. S. F. B. Morse, Associate Fellow; and of Professor Daniel Treadwell, Resident Fellow of the Academy.

The President read a note from Mr. John Noble, announcing a large legacy to the Academy by Professor Treadwell.

On the motion of Dr. E. H. Clarke, it was voted that the President be authorized to express to the executors and to Mrs. Treadwell the grateful sentiments of the Academy in accepting this gift.

The Recording Secretary read a report of the Committee appointed to consider a suggestion to change the rooms of the Academy.

It was voted that this report be accepted, and that the Committee be continued until the Annual Meeting.

Mr. Alexander Agassiz made a statement of some of the results obtained by the Hassler expedition.

Dr. J. B. S. Jackson exhibited some Mexican seeds which moved when laid on a heated plate, because of the presence on their interior of small living larvæ.

Six hundred and forty-fourth Meeting.

May 14, 1872. — MONTHLY MEETING.

The PRESIDENT in the chair.

On account of the absence of Mr. Theodore Lyman in Europe, the President nominated Mr. H. G. Denny to fill his place on the Committee to audit the Treasurer's account.

The President read a letter from the Vice-President, declining to be a candidate for re-election.

Professor W. A. Rogers read a paper on the observations already made with the large transit circle of the Cambridge Observatory.

Professor H. L. Eustis presented a communication on the truss constructed for the roof of the building called the *Coliseum*, in Boston.

Six hundred and forty-fifth Meeting.

May 28, 1872. — ANNUAL MEETING.

The PRESIDENT in the chair.

The Treasurer presented his report, which was accepted and ordered to be entered in the records.

The report of the Rumford Committee was read and accepted.

Professor Joseph Lovering read the report of the Committee on Publication, which was accepted and ordered to be entered in the records.

The Librarian presented his report, which was accepted and ordered to be entered in the records.

The President announced the death of Professor Albert Hopkins, of Williamstown, Resident Fellow of the Academy.

The following gentlemen were elected members of the Academy: —

J. H. W. Döllen, of Pulkowa, to be a Foreign Honorary Member in Class I., Section 2.

William Thomson, of Glasgow, to be a Foreign Honorary Member in Class I., Section 4.

Theodor Mommsen, of Berlin, to be a Foreign Honorary Member in Class III., Section 3.

James Martineau, of London, to be a Foreign Honorary Member in Class III., Section 1.

Benjamin Jowett, of Oxford, to be a Foreign Honorary Member in Class III., Section 2.

Karl F. Rammelsburg, of Berlin, to be a Foreign Honorary Member in Class II., Section 1.

William T. Roepper, of Bethlehem, Pa., to be an Associate Fellow in Class II., Section 1.

Mr. H. H. Hunnewell, of Wellesley, to be a Resident Fellow in Class II., Section 2.

Dr. H. P. Bowditch, of Boston, to be a Resident Fellow in Class II., Section 4.

The annual election resulted in the choice of the following officers: —

Asa Gray, *President.*
Charles Francis Adams, *Vice-President.*
Joseph Lovering, *Corresponding Secretary.*
Edward C. Pickering, *Recording Secretary.*
Edmund Quincy, *Treasurer.*
Edmund Quincy, *Librarian.*

Council.

Thomas Hill, Josiah P. Cooke, Jr., John B. Henck,	of Class I.
Alexander Agassiz, Jeffries Wyman, Chares Pickering,	of Class II.
Robert C. Winthrop, George E. Ellis, Andrew P. Peabody,	of Class III.

Rumford Committee.

Morrill Wyman,
Wolcott Gibbs,
Josiah P. Cooke, Jr.,
James B. Francis,
John M. Ordway,
Stephen P. Ruggles,
Edward C. Pickering.

Committee on Finance.

Asa Gray, Edmund Quincy,	*ex officio.*
Thomas T. Bouvé.	

The other Committees were appointed, on the nomination of the President, as follows: —

Committee of Publication.

W. W. Goodwin,
Jeffries Wyman,
John Trowbridge.

Committee on the Library.

H. G. DENNY, J. D. RUNKLE,
JULES MARCOU.

Auditing Committee.

THEODORE LYMAN, H. G. DENNY.

Six hundred and forty-sixth Meeting.

June 4, 1872. — ADJOURNED ANNUAL MEETING.

The PRESIDENT in the chair.

Dr. Maack gave a description of the explorations he has been making on the Isthmus of Panama.

Professor N. S. Shaler presented a communication on the topography of Narragansett Bay.

The Annual Report of the Council was presented by Professor Joseph Lovering, the Corresponding Secretary, and ordered to be printed.

Since the last report of the Council the following additions, by election, have been made to the membership of the Academy: —

Francis L. Pourtales, of Cambridge, to be a Resident Fellow in Class II., Section 3.

Robert Amory, of Brookline, to be a Resident Fellow in Class II., Section 3.

R. W. Hooper, of Boston, to be a Resident Fellow in Class II., Section 4.

J. B. Perry,* of Cambridge, to be a Resident Fellow in Class II., Section 1.

S. P. Sharples, of Cambridge, to be a Resident Fellow in Class I., Section 3.

G. R. Baldwin, of Quebec, to be a Resident Fellow in Class I., Section 4.

H. G. Denny, of Boston, to be a Resident Fellow in Class III., Section 2.

John Trowbridge, of Cambridge, to be a Resident Fellow in Class I., Section 3.

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* Printed J. B. Pettee, by mistake, on page 335.

J. A. Allen, of Cambridge, to be a Resident Fellow in Class II., Section 3.

William H. Pettee, of Cambridge, to be a Resident Fellow in Class II., Section 1.

John K. Paine, of Cambridge, to be a Resident Fellow in Class III., Section 4.

Edwin P. Seaver, of Cambridge, to be a Resident Fellow in Class I., Section 1.

Charles F. Dunbar, of Cambridge, to be a Resident Fellow in Class III., Section 3.

William A. Rogers, of Cambridge, to be a Resident Fellow in Class I., Section 2.

Samuel Johnson, of New Haven, to be an Associate Fellow in Class I., Section 3.

Charles A. Young, of Hanover, N. H., to be an Associate Fellow in Class I., Section 2.

Leo Lesquereux, of Columbus, Ohio, to be an Associate Fellow in Class II., Section 2.

Since the last annual meeting, the Academy has lost by death nine Foreign Honorary Members, four Associate Fellows, and three Resident Fellows.

George Grote died in London, June 18, 1871. He was born November 17, 1794, at Beckenham, Kent, and received his early education at the Charterhouse School. At the age of sixteen he entered the banking-house of Prescott, Grote, & Co., in London, of which his grandfather had been the founder, and in which his father was still a partner. It was a strange fate which sent to a bank rather than to the university a young man of ample means, already inspired with a love of ancient learning, who was destined to revolutionize the opinions of scholars on important points of Grecian history, antiquities, and philosophy, and to make himself a recognized authority on these subjects, not merely at home, but even among the most learned scholars of the Continent. Considering the period at which he would have entered academic life, we may, perhaps, doubt whether the fate that guided him was not propitious to the cause of learning. His own studies, conducted without teachers, and perhaps not without a little willing opposition to the traditions of English scholarship, led him into the purer and freer air and to the wider views of German learning, at a time when he might have found Oxford and Cambridge still singing the old song, "The Germans at Greek are sadly to seek." It must, indeed, have been no ordinary enthusiasm that impelled a young man, under such circumstances, to undertake what is perhaps the most thorough study of the whole Greek literature — poets, historians, and philosophers — ever accomplished by a self-educated man in modern times. It was not, as has sometimes been thought, his parliamentary experience that caused him to study the constitution of ancient Athens; nine years before he entered public life we find him preparing for his History of Greece, the first volume of which, however, was not published until 1846, twenty-three years later. The original research and the profound learning which this work displayed, even in its earliest volumes, testify to long years of hard and patient study. There is no easy or short road to learning of this nature. In 1832, his literary labors were interrupted by his election to the House of Commons as member for the city of London. He remained in Parliament nine years, and distinguished himself especially by what was called his "annual motion" for the ballot. In his later years, when his favorite scheme was brought into Parliament as a ministerial measure, he could well afford to smile at the ridicule with which it was once greeted on all sides. His public life delayed, perhaps fortunately, the publication of his History. In the mean time, Thirlwall's "History of Greece" appeared, which took an immense step in advance of the Tory views of Mitford, but did not aim at such an overthrow of English opinions and prejudices about Greek democracy as Grote contemplated. That literary men, even out of England, were expecting Grote's History with interest, appears from a letter of Niebuhr (who died in 1831), in which he advised a friend to translate the coming work into German as soon as it should be published. In the years 1846 – 1856 were published the twelve volumes of Grote's "History of Greece." Nine years later was published his other important work, "Plato, and the other Companions of Sokrates," in three volumes. If his History astonished scholars by the intimate acquaintance of a self-educated man with the Greek historians and poets, his Plato called forth new surprise, that a man so pre-eminently practical as Mr. Grote, whose sober common-sense was one of his great virtues as an historian, should prove equally familiar with the great idealist of antiquity, whose whole mode of thought and reasoning was in constant conflict with his own. It often seems, indeed, as if the pleasure of refuting the many absurd theories which were current about Plato and his works made up to Mr. Grote for the patient toil by which he must have mastered many elaborate and often tedious arguments of the Platonic Socrates, leading to conclusions the furthest possible removed from his own sympathies. At the time of his death, he was preparing for the press a similar work on Aristotle; and it can hardly be doubted that the same sagacity, joined with a deeper sympathy with the author and the subject, would have made this the crowning work of his life. It remains to be seen how far the posthumous work, now daily expected, will realize the expectations of scholars.

It was not to be expected that the graduate of a London bank, who had known no higher institution of learning than the Charterhouse School, should be as familiar with all the nice details of classical scholarship as if he had been trained at a university. But no modern historian of Greece was ever more thoroughly imbued with the whole spirit of classical antiquity, or ever viewed the field from a more commanding position. Although his views have often been violently attacked, and especially his defence of Athenian democracy in its least defensible points, his writings have yet produced a gradual change in the feelings of nearly all scholars towards even the weaknesses of Athens. No one, for example, will ever again attack the Sophists indiscriminately as a corrupt sect of philosophers, with a common creed and a common purpose of corrupting the youth of Athens. Even Cleon, that coarsest product of Attic democracy, will perhaps fare a little better at the hands of subsequent historians for having found a friend in Mr. Grote; it may be doubted, however, whether the historian would not have understood Cleon and his class better if he had spent nine years in Congress instead of in Parliament. Perhaps nothing in Grote's works has been so severely criticised as his defence of ostracism; and yet it was defended on nearly the same grounds by Aristotle, when it was almost as much a thing of the past as it now is.

During the later years of his life, Mr. Grote was Vice-Chancellor of the University of London, and one of the Trustees of the British Museum. It is understood that he was offered a peerage about two years before his death, and declined it on the ground that he must devote the remainder of his strength to his work on Aristotle. The long list of honorary titles which have been gradually added to the simple "George Grote, Esq.," which appears on the title-page of his History, show the respect in which he was held by scholars at home and abroad; and the impressive funeral service at his grave in Westminster Abbey, in which the highest officers of state appeared as mourners, was a fitting testimonial to the modest scholar, who had done more than any other man of the present generation to exalt the name of England in the department of ancient learning.

(August) Immanuel Bekker was born in Berlin, May 21, 1785. He studied at the gymnasium of his native city, and in 1803 he entered the University of Halle, where the great founder of the modern school of German classical philology, Friedrich August Wolf, was at the height of his reputation as a lecturer. Wolf was not long in discovering the ability and the persevering patience of his scholar, and the relations between the master and the pupil soon became intimate. Bekker was retained at Halle, after his regular term of study was ended, as assistant to Wolf in the Philological Seminary. While he was a student, he wrote his review of Heyne's smaller edition of the Iliad, which appeared in the Jena *Allgemeine Litteratur Zeitung*, in 1806, and was afterwards reprinted, in 1863, in Bekker's *Homerische Blätter*. The boldness with which he attacked the weak points in Heyne's work is in strange contrast with the gentleness which distinguished the great critic in his later years; and, on reprinting the review fifty-seven years afterwards, Bekker apologizes for the "jugendliche Keckheit" of his first essay, the tone of which (he says) was approved and encouraged by his master and patron, Wolf. As to Heyne, he confesses that, as a young man of twenty, he knew him only as a grammarian, "den vielseitigen von Einer, und der schwachen, Seite." His review of Wolf's Homer, published in 1809, in a more respectful but decidedly critical spirit, did not meet the same unqualified approval of his master, if we may judge by a note of Wolf, which Bekker quotes in the preface to the *Homerische Blätter*.

In 1810, Wolf was called from Halle to a professorship in the new University of Berlin; and Bekker soon followed, through Wolf's influence, as extraordinary professor. In the very year of his appointment, Bekker received a leave of absence, to enable him to begin the labor to which no small part of his active life was to be devoted, that of collating classic manuscripts. He went first to Paris, and the earliest fruit of his labors appeared in 1811, in the publication of the important grammatical work of Apollonius Dyscolus, *De Pronomine*, never before printed. In 1812, he was appointed to a full professorship at Berlin, which office he held fifty-nine years, until his death in June, 1871. Bekker spent, according to his own estimate, seventeen years of his life in collating manuscripts in France, England, Germany, and Italy; and the present generation of classical scholars are, perhaps, too little aware of the debt of gratitude which they owe to this quiet, indefatigable worker. It would be easier to enumerate the Greek authors who were not edited by Bekker than those who were. The shelves of every classical library will soon supply more names than any two other editors could claim; and the critical apparatus with which his editions of the most important authors were enriched has been of more permanent value than any exegetical commentary. We may mention his editions of Plato (1816, 1817), of Thucydides (1821), of the Attic Orators (Oxford, 1822, 1823; Berlin, 1823, 1824), of Herodotus (1826), of Aristophanes (1829), of Aristotle (Berlin, 1831 – 1836; Oxford, 1837), and of Homer (1843, Iliad; 1858, Iliad and Odyssey). We may mention, among his editions of Latin authors, those of Livy (1829, 1830) and of Tacitus (1831). In many cases, the labors of Bekker have served, or are still serving, as a basis for later scholars to determine the authentic text. A striking instance of this may be seen in Bekker's later edition of Demosthenes (1854), in which a text is given which differs on every page from that of the *Oratores Attici* (1823), but which could never have been determined with such certainty without the careful collation of fifteen manuscripts which the earlier work contains. It needed the experience of the earlier edition to show Bekker himself the true use of his immense material, and to determine the principles of criticism on which the text of Demosthenes is now by universal consent established with as great certainty as we can ever hope to attain in the text of a classic author.

Bekker seems never to have distinguished himself as a public lecturer at Berlin in any degree proportionate to his fame and merit as a scholar. He preferred his more quiet work in the library to giving instruction to classes; and students who knew him only as a professor (if any such there were) could never have appreciated his profound scholarship and his critical sagacity. His dislike of long commentaries and *prolegomena* often kept him utterly silent when he alone could have spoken with authority; and when he broke his rule, and wrote a note or a preface, his brevity was often more tantalizing than his silence. His conversation was marked by the same laconic brevity as his writings; and the remark of an intimate friend, "Er schweigt in sieben Sprachen," was one of the commonplaces of Berlin society. Notwithstanding his retiring disposition, his company was eagerly sought by the most cultivated scholars, and his hospitable house in Berlin was one of their most frequent resorts. No scholar, perhaps, ever lived, at least in Germany, who had stronger friends, greater admirers, or fewer enemies than Immanuel Bekker.

SIR RODERICK IMPEY MURCHISON died on the 22d of October, 1871, in his eightieth year. In his death the world has lost one who, in the popular estimation, not only shared with Lyell the sceptre of dominion among British geologists, but held, conjointly with him, a sort of universal empire. The labors of both of these men have extended beyond their country, and they have made not only Europe but America tributary to their reputation. Of these two, Lyell still remains, and, as his latest work, published in 1870, shows, retains unimpaired that clearness of style and that rare philosophic acumen which have made his masterpiece the *Principia* of modern geology, — a classic which future generations will study with the same delight as the present. Very different have been labors, and unlike the gifts of Murchison. Like Lyell and his distinguished predecessors, the earlier prophets of the Scottish school of geology, — Hutton and Playfair, — Murchison was a Scot, and was proud of his ancient Celtic pedigree. It is characteristic of the man, that, a few years since, he raised in the Highlands of his native land a monument to one of his Jacobite ancestors, who had sacrified fortune and life in the cause of the exiled Stuarts. The father of Sir Roderick was a physician who, in the last century, amassed a fortune in India, where he was a friend of the noted Elijah Impey. Marrying soon after his return, he purchased an estate at Tarradale in Rosshire, where his son, the subject of the present notice, was born in 1792, and was early left an orphan by the death of his father.

Like many others who have gained an honorable name in British geology, Murchison had not the advantage of a university training; but, after some years at a grammar-school in Durham, entered the army at the age of sixteen, and was soon ordered to Spain, where he served with distinction under Wellington; carrying the colors of his regiment in a desperate charge at Vimieira, and being left wounded on the field at Corunna. At the close of the war, he left the service, a captain of dragoons, and, returning to England, married in 1815. Possessed of wealth and social position, he seems for the next few years to have given himself to fox-hunting and the usual amusements of his class;

and he is said to have been first led to study by his wife's fondness for natural history. Meeting in 1818 with Sir Humphry Davy, he was induced, by his advice, to follow the lectures of the Royal Institution in London: and shortly afterwards placed himself under the tuition of Professor Richard Phillips, the well-known mineralogist. The attention of Murchison was soon drawn to the study of geology, then taking shape from the labors of Cuvier, Buckland, and Conybeare; but it was not until 1825 that he made his first contribution to the science, in a paper on the geology of parts of Sussex and the adjoining counties. Already he had formed an acquaintance with William Smith, who, by his careful studies of organic fossils and their stratigraphical relations, had laid the foundations of British geology. It was also his great good fortune to know Sedgwick, then commencing his laborious career, who became for many years his friend and companion in the field, and with whom, in 1827, he visited the Highlands of Scotland. In 1828, Murchison accompanied Lyell in a journey to the volcanic districts of central France, to northern Italy and the eastern Alps; and to the latter region he returned and labored with Sedgwick in 1829 and 1830. In 1831, he and Sedgwick began simultaneously, in different districts, the task of discovering the geological succession of the older fossiliferous rocks of Wales, of which they first gave the definite results to the world in 1834 and 1835. The fruits of Murchison's labors in this field were published in 1838–39, in two magnificent volumes, entitled "The Silurian System," and dedicated to his friend Sedgwick. Meanwhile, in 1836 and 1837, the two friends labored together in the investigation of the geology of Cornwall and Devonshire, and in 1839 extended their studies to the Rhenish country and to the Hartz Mountains, publishing conjointly their results.

In 1840, Murchison was invited to Russia by the Czar, and there spent two or three years with De Verneuil and Von Keyserling in investigating the geology of that country. The results of these labors, extending over the greater part of European Russia, appeared in 1845, as the joint production of Murchison and his fellow-workers. He subsequently made repeated visits for the purpose of geological investigation to Scandinavia, Germany, and the Alps; and in 1856, in conjunction with Professor Nicoll, published a valuable geological map of Europe.

In 1854 appeared the first edition of his well-known book, *Siluria;* which, besides a revision of his work done twenty years before, in the Silurian region of Great Britain, contained an excellent summary of the paleozoic geology of Europe. Of this volume four editions have appeared, the last in 1867, much augmented, and in great part re-written.

In 1855, on the death of Sir Henry de la Beche, Murchison was named in his place as director-general of the Geological Survey of the United Kingdom, a post which he resigned not long before his death. His activity as a geological investigator still continued. From 1855 to 1860 he turned his attention towards the Highlands of Scotland; and in 1861 published, in connection with Professor Archibald Giekie, a geological map of Scotland, with an introductory sketch, which is a valuable contribution to the literature of the subject, and sets forth briefly the great differences of opinion which had arisen between Murchison and his friend Professor Nicoll, as to the geological age of the crystalline schists of the Scottish Highlands. Besides the works already noticed, Murchison is said to have published during his long scientific career, extending over forty-five years, more than one hundred memoirs by himself on British and Continental geology, besides upwards of twenty in connection with other investigators.

The secret of his scientific success is to be found, in great part, in his methodical habits and his untiring industry. The observations of each day in the field were written out fully at night, and, while in town, the early hours of the morning were devoted to his literary labors. Murchison's scientific services were such as could not fail to attract attention and receive acknowledgment. To his scientific honors, which culminated in 1868 in his election as one of the eight foreign members of the French Academy of Sciences, were added titles and distinctions from princes and governments, both at home and abroad, among them the rank of Baronet of the United Kingdom. If these well-earned social honors were highly prized, no less by the courtier than the *savant*, it may be fairly said that he regarded them as a homage paid through him to science, and that he strove to turn them to good account in its service, as became his genial and kindly nature.

In forming an estimate of his scientific character, it must be said that his works show no such extensive acquaintance with geological history and literature as those of Lyell. He was not learned in chemistry, mineralogy, nor lithology; and, although skilfully availing himself of the evidences furnished by organic fossils, owed his paleontological determinations to others. His great merit as a geologist seems to have been a quick perception of the aspects of the rocks, and a happy facility in grouping and presenting the facts and observations of himself and others. Professor Giekie, in a recent biographical sketch, speaks of the rare acumen with which Murchison seized the geographical details of a region, and thence deduced the general arrangement of its rocks. His opinions, however, were either adopted from others, without much critical examination, or, in the case of his own observations, often formed hastily, and upon insufficient data; and very many of his conclusions are already inadmissible. Most of his deductions in the geology of the Alps appear, when viewed in the light which Studer, Lory, Pillet, and especially Favre, have thrown upon that region, to be fallacious. His conclusions as to the age and geological structure of the Scottish Highlands, although sustained by the members of the government survey, are rejected, apparently with good reason, by Professor Nicoll; while the subsequent investigations of Sedgwick and of the government surveyors have long since shown that the arrangement of the rocks to which he gave the name of Lower Silurian was based upon a series of mistakes in observation, and that the rocks thus called are identical with the upper division of the Cambrian series of Sedgwick. The history of the Cambrian and Silurian controversy, which alienated him from his old friend Sedgwick, and for the last thirty years has troubled geological nomenclature, is a long one, which has been lately fully discussed elsewhere. Indeed, it would appear that the nomenclature and classification of Murchison, hitherto so generally adopted for the paleozoic rocks, will be replaced by that of Sedgwick, the exactitude of whose early stratigraphical determinations has been fully established by the results of recent investigators both in Europe and America.

FREDERIC ADOLF TRENDELENBURG, Perpetual Secretary of the section of history and philosophy in the Royal Academy of Sciences at Berlin, and a Foreign Honorary Member of this Academy, died in Berlin in January, 1872. In him we regret the loss of one of the great metaphysicians of his country, the most eminent, indeed, as a scholar and a thinker in the department of philosophy, that Germany could boast of since the death of Hegel, Herbart, and Schelling. With these illustrious men his own name must always be associated, not as one who subscribed to their doctrines, but who followed generally the same lines of investigation, and by an acute, learned, and comprehensive criticism of their writings prepared the way for the reception of his own metaphysical theories. Whatever their adherents and followers may have thought of the justice of this criticism, none denied its ability, or the fairness with which it was stated, or the competency of its author, arising from his thorough comprehension of the systems which he impugned, to judge of their merits. As a dialectician, he was unrivalled among German professors of philosophy. But he was also something more and better. He thought and wrote on the most abstruse subjects with singular clearness, precision, and elegance, and with more caution and good sense, and a stricter regard for the great interests of morality and society, than was common with many of the able speculatists who had preceded him in a chair of philosophy in a German university. Of the merits of the peculiar system which he propounded in his principal work, the *Logische Untersuchungen*, first published in 1840, and which passed to a third edition only two years ago, we must speak with less confidence. Whether motion is the common and characteristic function both of matter and mind, and whether motion directed by purpose or final cause supplies the means of bridging over the abyss between thought and real being, is more than most metaphysicians of the present day will acknowledge. Those who may arise in some future age, more competent to settle grave disputes of this nature, must decide. But some of the doctrines and arguments incidentally developed in setting forth the main features of his system will always commend themselves to sober judges, as evidences of the dialectical shrewdness, the sterling common-sense, and the justness of thought of their author.

Trendelenburg seems to have left but few materials for biography. Indefatigable as a student and with his pen, a list of his writings is, in the main, a history of his life. Born at Eutin in Oldenburg, in November, 1802, he studied at Kiel and Leipsic, took the degree of Doctor in Philosophy in 1826, and was appointed Professor of Philosophy in the University at Berlin in 1833, two years after the death of Hegel. He first occupied himself with the works of Aristotle, an edition of whose *De Anima* he published in 1833. This was followed, four years later, by the *Elementa Logices Aristotelicæ*, which is a standard work on the subject, and arrived at the honors of a fourth edition in 1852. A "History of the Doctrine of the Categories," first published in 1846, subsequently appeared as the first volume of the *Historische Beiträge*, the three later volumes of this work, completed in 1867, being occupied with a collection of the memoirs, critical and philosophical, which he had contributed at various times to the "Transactions of the Royal Academy." As the result of his inquiries respecting the nature and foundations of morality, he published a work entitled *Naturrecht auf dem Grunde der Ethik,* which appeared in a second edition in 1868. Second only to the "Logical Researches," this book was the most thoughtful and original of his writings, and the most characteristic of the man. Several smaller essays on the theory of æsthetics need not be here enumerated.

In 1849, probably to his own astonishment, the city of Berlin elected him as one of its members to the lower house of the National Assembly. Here he generally voted with the conservative party, and published an essay on the methods of voting (*über die Methode bei Abstimmungen*). When the cause of the union of Germany was abandoned, he resigned his seat in the house, in 1851, and went back to those academic labors which occupied his whole life, with the exception of this brief political episode.

HENRY LONGUEVILLE MANSEL, D. D., Dean of St. Paul's, died in London, July 31, 1871. Though he had not completed his fifty-first year, he had done the work of a long life. His publications were numerous and important, exerting manifest influence on the course of speculative thought not only in England, but wherever the moral sciences had a home. As a scholar and a thinker in the various departments of philosophy, he had hardly a rival on English ground after the death of Sir William Hamilton. Equally eminent in logic, metaphysics, natural and doctrinal theology, his writings never failed to attract notice and command respect, though they often excited vehement controversy. His Brampton Lectures on the "Limits of Religious Thought," first published in 1858, when he was but thirty-eight years old, passed through three editions in a twelvemonth, and have probably affected the character of English thought in philosophy and theology more than any single work which has appeared since the days of Bishop Butler. In the earnest discussions which it immediately occasioned, and in which such distinguished men as F. D. Maurice, James Martineau, Goldwin Smith, and John S. Mill had a prominent share, Mr. Mansel appeared to great advantage. His stores of learning were immense; equally at home in Greek and German philosophy, in the speculations of the Schoolmen, and in the writings of the fathers of the

English Church, with almost unrivalled powers of clear statement and forcible argumentation, and a great mastery of English style, he either obtained an easy victory over his eminent opponents, or, even in the judgment of their disciples and admirers, left them no cause for triumph. Yet he was modest and candid in manner, an urbane and dignified controversialist, disarming his assailants as much by his flowing courtesy and frank acknowledgment of their claims to respect, as by his dialectical skill and abundant erudition. Once only, when provoked by continuous misrepresentations no less than by coarse invective and sneers, he retorted with terrible severity, and compelled his opponent to make an apologetic defence. This was the only unpleasant episode in Mr. Mansel's brilliant and prosperous career. His genial manners, ready wit, and quick sympathy with others, made him a great favorite in a large circle of acquaintances and friends. Even as a politician — and he was for years a leader of the conservative party at Oxford — he incurred no enmities and gave no personal offence. The manliness and simplicity of his character allowed no hold for envy or jealousy; and it cost him no effort to gain and preserve great personal popularity.

The family of Dean Mansel was distinguished before his time both in the universities and the Church. One member of it had been Master of Trinity College, Cambridge, and another was Bishop of Bath and Bristol. His father was Rector of Cosgrove, Northamptonshire, a family living, where the late Dean was born on the 6th of October, 1820. Educated at Merchant Taylors' School, he became the leader of his class at that institution, and thus, in 1839, acquired a Junior Fellowship at St. John's College, Oxford, and was graduated four years afterwards as Double First, or with the highest rank both in the classical and the mathematical list. This success obtained for him a tutorship in the College, and his lectures upon logic soon made him famous in the University. In 1849 he published Aldrich's "Rudiments of Logic," with an Introduction and copious Notes, of which Sir William Hamilton observed that *la sauce vaut mieux que le poisson.* The work passed rapidly through three editions, and made its author known as one of the ablest and most learned logicians of the age. Two years afterwards appeared his *Prolegomena Logica,* which was based upon the philosophy of Kant, and contained the germs of all his subsequent speculations. It was reprinted in this country in 1860, from the second English edition, and has been a standard work in the

University course of instruction upon metaphysics on both sides of the Atlantic. In 1855, Mr. Mansel was appointed Waynflete Reader in Moral and Metaphysical Philosophy, and four years afterwards, when the recommendations of the University Commission took effect, he became Waynflete Professor. Dr. Stanley's appointment as Dean of Westminster having created a vacancy, Mr. Mansel was made Professor of Ecclesiastical History and a Canon of Christ Church; and in 1869, he succeeded Dr. Milman as Dean of St. Paul's.

In philosophy, Dean Mansel is commonly regarded both as a follower of Kant and as a disciple of Sir William Hamilton. This opinion does him great injustice, for though he adopts Kant's premises, it is for the avowed purpose of refuting Kant's conclusions; and he departs widely from Hamilton, both in his theory of Causation, and in his application of the Philosophy of the Conditioned to an exposure of the illogical character of theological rationalism and dogmatism. His modesty did not allow him to do justice to his own claims as an original thinker and a philosophical theologian. He seems not to have been ambitious to found a school, or to establish a new philosophical system. His aim was rather to rebuke the pretensions and expose the shallowness of those metaphysical infidels who have endeavored to reconstruct the doctrines either of Spinoza, Hume, or Hegel, for the avowed purpose of destroying the basis of all religious faith and hope. The ablest and most scholarly refutation of such pantheistic and atheistic speculations which the philosophy of the present age has furnished can be found in the several publications of Dean Mansel. Vehemently assailed as these have been by the enemies of conservatism in philosophy and theology, they have earned for their author a high place in the list which contains the honored names of Clarke, Cudworth, Butler, and Berkeley.

CHARLES BABBAGE was born in London, on the 26th of December, 1792, and, after a long life of nearly eighty years, died October 20, 1871. As a boy, his health was much weakened by violent fevers, and, accordingly, he was sent to school near Exeter, with instructions that much study should not be required of him. Here he early displayed the inquiring mind and ingenuity for which, in after life, he was so eminent. In 1811 he entered Cambridge, and graduated at the University in 1814. At this time the College was agitated by a fierce controversy, whether it was right to add notes to the Bible, each party forming societies and using every means to establish its views. Babbage parodied it by forming the Analytical Society to propagate the notation of Leibnitz, using the differential *d* in the calculus, and consigning to perdition all who supported the heresy of the *dots* of Newton. Being accused of infidelity, the members entitled the first volume of their transactions "The Principles of Pure D-ism in Opposition to the Dot-age of the University." They proposed to translate a small work of Lacroix on the Calculus, maintaining that it was so perfect that any comment was unnecessary.

In 1828, while in Rome, Babbage was elected Lucasian Professor of Mathematics at Cambridge; a chair first occupied by Sir Isaac Newton. After filling it for eleven years, he resigned, finding even the few duties it involved too much for his strength in addition to his other work. He bitterly calls it the only honor he ever received in his own country.

We now come to the great work of his life, and that by which he is best known to the public, namely, the construction of an engine for performing numerical computations. As early as 1813 he turned his attention to this matter. One evening, when sitting in the room of the Analytical Society, leaning his head on the table, another member, coming in, called out, "Well, Babbage, what are you dreaming about?" To which he replied, "I am thinking that all these tables (pointing to a table of logarithms) might be calculated by machinery." In 1822 he completed his first Difference Engine, which was capable of working two orders of differences, and computing six places of figures. It was highly approved by the Royal Society, and, in accordance with their recommendation, the government appropriated £1,500 for the construction of a large engine to compute eight orders of differences to sixteen places of figures. For four years the work was carried on uninterruptedly, but then various difficulties presented themselves. As it appeared that the cost would be much greater than was originally anticipated, the government was informed of the fact. More money was obtained; but, owing to the delay, the engineer who had entire charge of the construction withdrew, taking with him all the tools, the labor of years. A lawsuit ensued, but he was finally allowed to retain them. The work now went on at intervals, but finally a new idea occurred to Babbage of a machine whose powers should vastly exceed those of the Difference Engine. He called it the Analytical Engine, and it is difficult to describe, in a short notice like the present, the wonderful powers of this machine. It bore about the same relation to the other that algebra does to arithmetic, and, instead of merely computing arithmetical tables, it was designed to deal with all forms of analytical operations. Suppose we have any formula whatsoever from which we wish to compute a series of numerical values. Two sets of cards, like those of a Jacquard loom, are furnished the engine, the first to direct the nature of the operations to be performed, and the second to show which variables are to be acted upon. The numerical values of the constants being placed on the wheels, it would compute and print the results of the formula. If, during the operation, it wanted some other quantity, as the logarithm of a given number, it would ring a bell, and then stop. The attendant would find out what was wanted, and, procuring the logarithmic card, would place it in the machine. The latter would first see if it was correct, and, if not, would ring a louder bell and again stop. It would express every number it used to fifty places of figures, and would multiply two such numbers, giving a hundred places in the product, in about a minute. The complication of this instrument was such that it was impossible to represent it by ordinary drawings. Babbage, therefore, used a system of mechanical notation which he had devised, and without which he claimed that it could not have existed even upon paper.

In 1833, a portion of the Difference Engine was put together and worked admirably, computing tables with two or three orders of differences to sixteen places; but, unfortunately, the new invention seemed to supersede it, and finally, in 1842, the government, after spending £17,000 on the project, refused to give any further aid. Babbage now devoted his whole attention to the engrossing subject of the Analytical Engine, and succeeded so far that, with sufficient means, there seems to be little doubt that he would have attained all that he claimed.

His health suffered severely from the intense mental strain to which he was subjected in designing his engines, and, in consequence, he travelled a great deal both in England and on the Continent. As he seems to have availed himself of every opportunity to inspect in person any novelty he met with, we find him in many strange positions, and often narrowly escaping serious accidents. Thus, as a boy he was nearly drowned while testing a swimming-machine he had constructed. Again, in the Thames Tunnel, in company with Brunel, the water breaks in, and, but for the presence of mind of the latter, both would probably have been drowned. Later he descends in a diving-bell, in a coal mine is surrounded by explosive gases, enters the air-chamber of a blast furnace, also an oven for baking moulds at a temperature of 265° F., and finally descends the crater of Vesuvius between two eruptions which are taking place periodically at intervals of ten or fifteen minutes. In the early days of railroads he made many experiments on them; and one Sunday morning, when just about to start on an experimental train with thirty tons of pig-iron on board, narrowly escaped a collision with Brunel, who came down the line on an engine at the rate of fifty miles an hour.

He was elected a member of most of the principal scientific societies of the world, so that he was able to write after his name the titles, A. A. S., F. R. S., F. R. S. E., F. R. A. S., F. Stat. S., Hon. M. R. I. A., M. C. P. S., Inst. Imp. (Acad. Moral.) Paris Corr., Reg. Œcon. Boruss., Phys. Hist. Nat. Genev., Acad. Reg. Monac., Hafn, Massil., et Divion., Socius, Acad. Imp. et Reg. Petrop., Neap., Brux., Patav., Georg. Floren., Lyncei Rom., Mut., Philomath. Paris Soc. Corr., etc. His writings are somewhat voluminous. Among the most noted are the following. That "On a Method of Expressing by Signs the Action of Machinery" is a description of his Mechanical Notation. A good example of his talent for satire is a scathing criticism of the Royal Society, entitled "Reflections on the Decline of Science in England, and on some of its Causes." His most successful work was the "Economy of Manufactures and Machinery," which went through many editions, and was translated into German, French, Italian, and Spanish. To these must be added the "Ninth Bridgewater Treatise," and his autobiography, "Passages from the Life of a Philosopher."

As often happens with men of genius, when once interested in a subject he would devote his utmost powers to it, however trifling its importance; as, for instance, in reading ciphers, picking locks, and devising automata for playing games of skill. Or, again, when annoyed by street musicians, he displayed the same perseverance in prosecuting them as when urging the importance of his inventions on the government. As his engines have not been, and probably never will be, completed, many, doubtless, regard the life of Babbage as a failure. Yet in his own department he stood unequalled, and to him belongs the credit of devising the most complicated piece of machinery ever planned by the human mind.

Benoît Fourneyron was born October 31, 1802, at St. Etienne, France. He studied in the School of Mines of his native city, and began his career as a mining engineer in the mines of Creuzot. His attention was soon turned to water-wheels, and his experiments for improving horizontal water-wheels are said to have been begun as early as 1823. In 1827 his first turbine, constructed on the new principle of putting a cylindrical wheel with curved floats outside of a fixed cylinder containing curved guides, was set up at Pont sur l'Ognon. It was of six-horse power, and its efficiency was rated at eighty per cent. A second wheel of seven or eight horse power was erected in 1831 at Dampierre, and a third, of fifty-horse power, in 1832, at Fraisans. The success of this invention was so marked, that a prize of 6,000 francs, offered by the Society for the Encouragement of National Industry, for the best application to mills and manufactories of the hydraulic turbines of Bélidor, was awarded to Fourneyron in 1834. These wheels were soon introduced in various parts of France and Germany. One in the Black Forest worked under a fall of 354 feet. Gold medals were awarded to Fourneyron at the Industrial Expositions of 1839 and 1855, and a medal of honor at that of 1867. Fourneyron was Chief of Battalion of the National Guards in 1847, and in 1848 represented the Department of the Loire in the Constituent Assembly. He published papers on turbines, and on several other engineering subjects, in the Bulletin of the Industrial Society of Mulhouse for 1831, in the Bulletin of the Paris Society for the Encouragement of National Industry for 1834, and in the *Comptes Rendus* for 1836, 1837, 1840, 1841, 1843, and 1852. A treatise on turbines was published by him at Liege in 1841, and a table on the flow of water in pipes in 1844. He was elected a Foreign Honorary Member of this Academy, November 13, 1849. He died in Paris, July 8, 1867.

Hugo von Mohl, the acknowledged chief of the vegetable anatomists of this generation, died on the first day of April last. He was born at Stuttgard, April 8, 1805, the youngest of four brothers who all became men of mark in political and scientific life; Julius the orientalist and Hugo the botanist being the most distinguished. The latter was educated at the Stuttgard Gymnasium and Tübingen University, where he studied medicine as well as natural history and physics. His first publication, while a student, in the year 1827, was his Essay on the Structure and Soiling of Tendrils and Twiners, written in response to a prize-question offered by the Tübingen Medical Faculty. In it he divined the real nature of the movements which coiling stems and tendrils execute, as has recently been clearly made out. In the following year appeared his inaugural dissertation on the Pores of the Cellular Tissue of Plants, in which his later views and discoveries, respecting the structure, growth, and component parts of cells, as subsequently developed, are already foreshadowed. About this time his choice was made for a scientific rather than a medical career; and he went to Munich to prosecute more advantageously his favorite studies. Here the late Von Martius and Zuccarini were his botanical masters, and Agassiz, Karl Schimper, Braun, and Engelmann his fellow-students. Here he made those researches upon the anatomy of ferns, cycads, and especially of palms, — the latter a most important contribution to Martius's great work upon palms, the former also contributed to another work by Martius, — which first displayed his remarkable talents for histological investigation, to which his subsequent scientific life was mainly devoted. His merits were promptly recognized by a call to the Imperial Botanic Garden of St. Petersburg, as assistant to its director, Dr. Fischer, and to the chair of physiology in the Academy of Berne. He accepted the latter in 1832, and occupied it until 1835. Then, upon the death of Schübler, he returned to Tübingen, accepted the professorship of botany in its High School, in which chair and in that of Tübingen University the rest of his life was passed. Invitations to more prominent and lucrative positions, as, for example, to the botanical chair at Berlin University when vacated by the death of the veteran Link, were unhesitatingly declined. Although he published numerous (about ninety) special papers or articles, most of them important and timely, and some of great pith and moment, he resolutely declined to bring out any general work. His *Mikrographie* (1846) and his "Principles of the Anatomy and Physiology of the Vegetable Cell" are his only writings which may claim to be such. The latter, an admirable and still invaluable treatise, appeared as an article in Rudolf Wagner's Cyclopædia of Physiology, but is best known to English readers in its separate form, in a translation made by the late Professor Henfrey, with the author's sanction, issued by Van Voorst in 1852. A year or two later it was for a time understood, to the great satisfaction of botanists, that Mohl had agreed to take a prominent part in the production of a general Manual of the Anatomy and Physiology of Plants; but his promise was soon withdrawn. For thirty years he was one of the editors of the *Botanische Zeitung;* but the editorial labor must have devolved mainly upon Schlechtendal and his successor, although occasional articles from Mohl's pen appeared as late as the year 1871. During that year his health became seriously impaired; yet, as the new year advanced, apprehension disappeared. Upon Easter Monday he was apparently well, and so retired to nightly rest: in the morning he was found to have died in sleep.

JOHN F. W. HERSCHEL was born on March 7, 1792, and died on May 11, 1871, having nearly approached the advanced age of four-score of years. If there is any single spot on earth more memorable than all others in the history of astronomy, it is the observatory of William Herschel, the father, at Slough. Discoveries more and greater than have ever been made elsewhere have given to this little village a fame which will keep alive that of Windsor Castle, as the king, George III., wisely calculated when he placed the astronomer near him with a pension. Of this genius of the observatory, educated, like all of his nine brothers and sisters, to be a musician, it was said that he "had reached the middle of his course before his career of discovery began, and it was in the autumn and winter of his days that he reaped the full harvest of his glory." Here, at Slough, the father incessantly watched the stars for forty years, with a natural vision above that of ordinary mortals, assisted by optical contrivances of his own invention, which are scarcely surpassed by those of the generations which have entered into his labors. Here, also, was the home of Caroline L. Herschel, herself no ordinary astronomer, who left the world of science in doubt which most to admire, "the intellectual power of the brother, or the unconquerable industry of the sister." From this spot William Herschel sent to the Royal Society, in rapid succession, sixty-seven memoirs, richly freighted with his own glorious discoveries, which were the safe ballast by which he kept his mind from growing giddy with his bold speculations on the structure of the universal heavens. On this spot were discovered the satellites of the new planet, Uranus, and two additional satellites of the old planet, Saturn; on this spot was showered for the first time, in visible forms, the light of hundreds of nebulæ, and here was first dissected the blended lustre of more than five hundred double stars. Here were garnered up the proofs that the sun was not a fixed point about which the planets revolved, but that it was sent, in their company, on a mission of its own from star to star and from constellation to constellation, the full import of which cannot even now be more than surmised. The magnificent and almost solitary career of the elder Herschel is thus described by the late Sir David Brewster: "The springtide of knowledge, which was thus let in upon the human mind, continued for a while to spread its waves over Europe; but when it sank to its ebb in England, there was no other bark left upon the strand but that of the Deucalion of Science, whose home had been so long upon its waters."

On such a spot as this, and into such a home as this, the young Herschel was born. There are, no doubt, those, and not a few, on whom such high companionship, such inspiring examples, would have been wasted. There are in science, as well as in literature and all the other walks of life, examples enough of degenerate sons placed in saddest contrast with an illustrious ancestry. Happily for science, John Herschel was not of this class. His great career, as well as the few glimpses he has permitted the world to have into his early life, gives us the assurance that none of that untiring devotion to science, of those midnight watches among the stars, or of that incessant labor by day, which have made the name of Herschel a household word in all lands, was lost upon his young mind and heart. It was not in vain that the aroma of Science perfumed his cradle and his early childhood. By it, no doubt, he was won to lovingly enter her service and prepare himself to receive the mantle when it fell from the shoulders of his aged father. No microscopic autobiography has distinctly revealed to us the reality of what we can easily suspect. But the obituary notices of the Royal Astronomical Society inform us that John Herschel himself, in a few rare instances, has lifted the veil which obstructs our view by reporting the dialogues which he had with his father. These hints justify our inference that the boy, at an early age, was charged to reflect as well as to hear, and to see as well as to look.

Until Herschel entered St. John's College in the University of Cambridge, for which he was fitted at the early age of seventeen, his education was received chiefly at home, with private tutors. For, after a short trial at Eton, he was removed from that school in consequence of the abuse he endured from a stronger boy, the nature of which we do not know; but perhaps here it would be called *hazing*. At the University, he mastered Newton's *Principia*, and graduated as senior wrangler, the eminent mathematician, Professor George Peacock, being second on the list. If it be true, as has been pithily said, that God always works by geometry, the course which Herschel preferred at Cambridge was the best preparation he could have made for his great scientific career. And here again, doubtless, he owed something to a father's example. The world has been so dazzled by the brilliant results of Sir William Herschel's incomparable powers of vision, his bold scientific imagination, and his magnificent instruments, as not to see that he had also been a musician who entranced fashionable audiences in the theatre and concert-room and in oratorios, and that he studied algebra and geometry in order that he might master Robert Smith's "Harmonics, or the Philosophy of Musical Sounds." Arago has recalled from oblivion the fact that in 1779 Herschel gave the solution to a difficult problem on the vibrations of a loaded cord, which may be seen in Leybourn's edition of the "Ladies' Mathematical Diary." The younger Herschel, in the eulogy which he pronounced upon his worthy compeer, Francis Baily, makes this confession in regard to the state of science in England at the beginning of the present century: "Mathematics were at the last gasp, and astronomy nearly so." The ponderous notation of fluxions, which required the giant arm of a Newton to wield successfully, was retained at the English universities after science had outgrown it, and the finer methods of the Continental mathematicians were ignored. Herschel did his part, as student and graduate, to inaugurate the revolution which finally culminated in such mathematicians as Hamilton and MacCullagh, Sylvester and Gregory, Boole and Cayley, Tait, Adams, Airy, and Thompson. The president of the British Association in 1871 (a most competent witness) said: "In respect to pure mathematics, Sir John Herschel did more, I believe, than any other man, to introduce into England the powerful methods and the valuable notation of modern analysis." Herschel was one of the first to recognize the value of Hamilton's quaternions, which he described as a "Cornucopia from which, turn it how you will, something valuable is sure to fall." If Herschel had devoted his life to the development of the pure mathematics, as he seemed at first inclined to do, he might have taken rank with the highest in that field of investigation. His earliest publications were upon this subject, and he frequently returned to his first love, as late even as 1850. There is no occasion to regret that a mind of a high order, and thoroughly imbued with the mathematical spirit, should have been transplanted into the domains of geology, chemistry, physics, and astronomy, for there were fields there already white and waiting for a harvest, and only a mathematician could be the reaper. All of these sciences aspire to that high estate which some have already reached, when theories stand or fall according to the quantity as well as the quality of the forces which they furnish for the explanation of phenomena, — quantities which the highest mathematics are often inadequate to calculate.

Herschel moved from Cambridge to London, and began the study of Law. But the new acquaintance which he formed with Wollaston, the microscopic philosopher, as he has been called, soon turned his attention to Chemistry and Optics. His first publication in chemistry, on hyposulphurous acid, contained an important discovery, and was followed, at various intervals, by others, — on photography, on the chemical influence of light, on the action of light on precipitation, and on its effect upon vegetable colors. His investigations in Optics began at as early a date, and were not wholly relinquished until 1863. He applied the theory of diffraction to the explanation of the beautiful colors of mother-of-pearl; calculated the colored curves, called *lemniscates*, produced by the passage of polarized light through biaxial crystals; investigated Newton's *tints;* studied the aberration of lenses, the absorption of light by colored media, the light emitted by lime, the mineralogical import of *right-handed* and *left-handed* circular polarization in quartz, the irregularities of the colored rings in apophillite, the insensibility of some eyes to certain colors; discussed the merits of a fluid lens for the telescope; examined the coloring matter in certain green sands; suggested improvements in the Argand lamp; added the *lavender* tint to the solar spectrum; and finally, by his announcement of *epipolic dispersion* as exhibited on the surface of sulphate of quinine, furnished Stokes with the key to his important discovery of the change which luminous waves may suffer in their period of oscillation.

Notwithstanding the numerous successes which Herschel achieved as mathematician, chemist, and physicist, and the still greater triumphs in these directions of which he gave promise, he was destined by circumstances, if not by preference, to be an astronomer. The Royal Astronomical Society of London was founded in 1820, with William Herschel as its first President, and John Herschel as its first Foreign Secretary, and in the thirty-eight volumes of valuable memoirs which it has published, no other name shines so brightly as that of Herschel. If the illustrious F. G. W. Struve was animated, as he confesses, by the great example of William Herschel, to undertake his vast labor on the *Double Stars*, it is not strange that the younger Herschel should have been ambitious of reaffirming the discoveries of his father in the northern hemisphere, and of completing them by an independent survey of the southern stars and nebulæ. For this purpose, he was first associated with Sir James South, an amateur astronomer of immense zeal and ample means. The union was a happy one for both, and for astronomy, inasmuch as it placed at Herschel's disposal instruments of the first class, and secured to the work which had been undertaken the advantage of a highly gifted and well-trained mind. While this partnership lasted, observations and measurements were made on 380 double or triple stars, and promptly published.

Soon after this, we find Herschel established in the spot of greatest interest to all astronomers, and to him above all others, namely, in the old observatory at Slough. Provided with a reflecting telescope of 18 inches aperture, in the construction of which he had the advice of his father, he began to sweep the sky for double stars and nebulæ, as his father had done before him, and with equal success, though he missed the valuable assistance which his father had enjoyed in Miss Caroline L. Herschel. In spite of this disadvantage, and without the mechanical appliances which Struve enjoyed, and the still greater conveniences which both would have found in the chronographic method of recent times, catalogue after catalogue of double stars, clusters, and nebulæ, many of which had escaped the piercing eye of the father, poured into the volumes of the Royal Society and the Astronomical Society, and Slough became once more a centre of intense intellectual activity. Herschel was now more than forty years old. And if he had been less ambitious, or less courageous, or less devoted to astronomy, he might have been content with the laurels already won. But he knew that there was a new world of astronomy to be conquered in the southern hemisphere, — a zone of more than fifty degrees encircling the south pole, no star of which could ever shine in his telescope at Slough, however penetrating. Now and then an astronomer, like La Caille, had been despatched thither for a specific purpose and for a brief residence, and observatories, more or less permanent, had been established at the Cape of Good Hope and at Paramatta; but no one, before Herschel, had dreamed of making an exhaustive survey of those strange skies, of which the eloquent pen of Humboldt had depicted, and possibly exaggerated, the beauties. The motives and the object of Herschel in banishing himself, with his family and assistants, for four years, to the Cape of Good Hope, are best described in his own words. After alluding to what he and his father had done at Slough, he continues: "Having so far succeeded to my wish (the places of the objects thus determined proving, on the whole, satisfactory), and having by this practice acquired sufficient mastery of the instrument employed (a reflecting telescope of 14½ inches clear aperture and 20 feet focus on my father's construction), and of the delicate process of polishing the specula; being, moreover, strongly invited by the peculiar interest of the subject, and the wonderful nature of the objects which presented themselves in the course of its prosecution, I resolved to attempt the completion of a survey of the whole surface of the heavens, and, for this purpose, to transport into the other hemisphere the same instrument which had been employed in this, so as to give a unity to the results of both portions of the survey, and to render them comparable with each other."

Herschel sailed from England on November 13, 1833, with his family and instruments; and on his arrival at the Cape, January 15, 1834, he selected, as the site of his temporary observatory, Feldhausen, situated a little to the southwest of the Royal Observatory of the Cape. In a month his instruments were placed in position and ready for work. After luxuriating for a few nights, with laudable curiosity, on some extraordinary objects in the constellation of the Cross and of Argo, he began his regular *sweeps* of the southern sky on the 5th of March. When he had left the Cape, a granite monument was erected by friends, to commemorate the charming spot, at the base of Table Mountain, where his observatory stood. Few astronomers will have the privilege of seeing it. But they have the greater privilege of beholding always the nobler monument to the family name of Herschel, in the magnificent quarto volume, of nearly five hundred pages, illustrated with seventeen plates, which bears the august title, "Results of Astronomical Observations made during the years 1834, 5, 6, 7, 8, at the Cape of Good Hope; being the completion of a telescopic survey of the whole surface of the visible heavens, commenced in 1825," and dedicated to the late Hugh, Duke of Northumberland, by whose munificence the work was published.

A bare enumeration of the subjects of the seven chapters of this volume will give some idea of the variety and severity of the labor crowded into Herschel's few years of residence at the Cape. Chapter I. records that which energized the whole enterprise, namely, the registration of the nebulæ and clusters of the southern sky. Of these, 1708 are registered, most of them new to astronomy. Others, not wholly invisible in the northern observatories, were carefully re-examined by Herschel from his more favorable point of view. The Magellanic Clouds, that miscellaneous collection of individual objects in strange companionship, were dissected, and found to be composed, the one of 919 and the other of 244 distinct stars, nebulæ, and clusters. Chapter II. tells us that his catalogue of double stars, which had reached 3346 in the northern hemisphere, had grown by his southern contributions to 5542. Chapter III. marks the indomitable perseverance of the astronomer, who found relief from severer toil in determining the relative brightnesses of many of the southern stars. Neither did Herschel omit, as we learn from Chapter IV., to apply to the southern stars and the southern galaxy the system of gauging, instituted by his father, to discover the comparative *populousness* of the sky in different spots; on which, as upon a scientific basis, and not, as others had done before him, by mere speculation, he ventured an outlook into the structure of the universe. Probably an astronomer less zealous than Herschel would not have allowed the opportunity to slip of observing a comet as remarkable as Halley's, at its last appearance in 1835. But as we turn over the pages of Chapter V. of the *Results*, and rehearse the numerous observations therein recorded, and examine the admirable delineations of the changing phases of the comet, comparable in excellence with those which Schwabe and Bessel made in Europe, and ponder upon Herschel's weighty discussion of the physical condition of comets (better revealed by this comet than by any other except Donati's), we cannot but congratulate science on the well-timed visit of comet and astronomer. The two remaining chapters record observations on the satellites of Saturn and the solar spots. No one knew better than Herschel the need of new evidence for computing the orbits, or even verifying the existence, of these remote satellites; and the course of recent investigations into solar influences has given an importance to all good observations on the sun's spots greater than any one could have anticipated. Herschel realized, no doubt, that the new views of the celestial scenery which he had enjoyed, the intellectual gratification which he had received from his discoveries, and the filial duty that he had discharged to astronomy, were an over-payment for whatever he had sacrificed by a self-imposed banishment from his native land. Nevertheless, he had given to astronomers a bright example of the victory which a passion for truth may gain over present comfort and social enjoyment, and an example which others have been ambitious to imitate. His return to England was, therefore, as it deserved to be, an ovation.

If what Herschel did at Slough and at the Cape of Good Hope was the greatest work of his life, it by no means fills out the measure of his services even to astronomy. Among his miscellaneous contributions to scientific journals and transactions we find such subjects as these: Occultation of the Stars; Determination of Differences of Geographical Longitude; Parallax of the Fixed Stars; Orbits of Binary Stars; Biela's Comet and the great Comet of 1843; Revision of the Constellations; Satellites of Uranus; Variability of Stars; Test Objects for Telescopes; Entrance Passages into the Pyramids of Gizeh; and upon each and all might be inscribed, *Non tetigit quod non ornavit.*

Astronomy has done much for geography, and it promises to do more for geology, whenever the geologist shall have a moderate knowledge of astronomy, or the astronomer interest himself in the wonders of geology. Of various contributions which Herschel made to geology, two may be particularized. 1. He discussed with Lyell the effect which the position of the major axis of the earth's orbit might have on the comparative climates of the northern and southern hemispheres. 2. The startling and irregular changes in one of the stars of the constellation Argo, some of which came under his own inspection, suggested to Herschel reflections on the possible fluctuations in solar heat, and the consequent vicissitudes in the earth's history, which are worthy of the attention of every thoughtful geologist. Moreover, the scientific powers of Herschel were not confined to mathematics, chemistry, astronomy, and geology, for occasionally he made excursions into the domains of meteorology, magnetism, electricity, and general physics.

However broad the field over which Herschel travelled as an original investigator, he still found time to write elaborate treatises on special subjects. In the *Encyclopædia Metropolitana*, he has handled the subjects of Light and Sound in a masterly way. His contributions to this work were published forty years ago, but nothing has been written since in the English language that will supply their place, although the treatise on Sound requires now numerous additions to bring it up to the present state of the science of acoustics. The treatise on Light is rich in illustrations, experimental, mathematical, and historical, and contains an impartial presentation of the merits of the corpuscular and undulatory theories of light, and of the great services of Newton, Huyghens, Young, and Fresnel. The English reader owes especial regard to Herschel for his first introduction to Fresnel, the mathematical expounder of the undulatory theory of light; his scattered and tardily published writings having been first gathered and printed in an easily accessible form as recently as 1866. We have to thank the German and French translators for rescuing this treatise of Herschel on Light from the bulky and unwieldy volumes of the Encyclopædia, and printing it in a separate and convenient form. Herschel wrote two volumes for the Cabinet Cyclopædia of Dr. Lardner. "The Preliminary Discourse on the Study of Natural Philosophy" brought him into notice before a larger public as a writer and a philosopher. The objects and the methods of science, the meaning of natural law, and, of course, the analysis of phenomena and the process of generalization, the utility, dignity, and pleasures of science, are elegantly stated and vividly illustrated. This discourse was translated into German. The treatise on Astronomy, first published in the Cyclopædia in 1833 (and also translated into German), was expanded in 1849 into the "Outlines of Astronomy," which has run through ten editions. In this work, Herschel has handled skilfully the subject of planetary perturbations, without the use of the higher mathematics, and has given to the general reader imperfect glimpses of what must otherwise have been a sealed book to him; and everywhere the language is as grand as the themes of which it treats. In 1859 the "Outlines" was translated into Chinese.

Herschel did not disdain the task of writing for the people as well as for men of science. Three articles which he furnished to the *Encyclopædia Britannica*, on Meteorology, on Physical Geography, and on the Telescope, have been republished in separate volumes. After reaching the advanced age of threescore years and ten, he delivered a few lectures to a village audience, and then printed them, with other similar productions, in "Good Words." In 1868, they were collected into a small volume, with the title "Familiar Lectures on Scientific Subjects." But this must have been the amusement of his leisure hours, if it is possible to suppose that a man who did constantly so much heavy work had any leisure. How he refreshed himself after the midnight watches at the observatory, or amid the sterner labors of his study, all may know who will examine the volume issued in 1857 with the title, "Essays from the Edinburgh and Quarterly Reviews, with Addresses and other Pieces." These other pieces were poems, original or translated, while the Reviews and Addresses were upon the loftiest themes in science and philosophy, and abound in passages of magnificent diction, profound thought, and sublime eloquence.

The last years of Herschel's life, when he seemed to have retired from active service, were enriched with the fruits of his intellect and imagination. He is still poet, philosopher, mathematician, physicist, and astronomer, to his latest hour. Though his translation of the Iliad of Homer may give him a place as a classical scholar by the side of Pope, Blackie, Dart, Lord Derby, or our own Bryant, we can fancy the happiest moments of his life to have been when, in 1864, after having tardily published the seventh catalogue of observations at Slough, he gave to the world his one hundred and thirty-fourth scientific paper, namely, a highly elaborated catalogue of the five thousand and seventy-nine nebulæ which had been observed by his father, himself, or any other astronomer: or again when, undaunted by the growing infirmities of age, he labored at the stupendous task of framing a universal catalogue, with descriptions, of the ten thousand double stars hitherto registered, bequeathing the manuscript to loving hands, so as to secure its speedy completion and publication.

We may not forget the services which Herschel rendered to his country as Master of the Mint for five years, as President of the Royal Astronomical Society, and of the British Association for the Advancement of Science, or by the Instructions which he edited for the Board of Admiralty as a Manual of Scientific Inquiry, and to which he contributed his quota. We may also allude to the reports he made in behalf of the Magnetic and Meteorological Observatories established throughout the British Empire, and his efforts to establish a uniform standard of length. Fired by the example of Humboldt, he kindled his own country into a like enthusiasm in the study of Terrestrial Magnetism, which he watched and guided for twenty years, nerving his coworkers to undertake a first, second, and even third, magnetic crusade.

The tendency, and almost the necessity, of modern scientific study is strongly in favor of an exclusive devotion to some narrow specialty. Dissipation of energy is conditioned on superficiality, and the universal genius is regarded with suspicion. Nevertheless, the example of Herschel is an exhortation and an encouragement to the most liberal culture, by showing how many things can be done, and done well, when length of days, indomitable industry, and good natural endowments are united. It is to the credit of humanity and of science that the merits of Herschel were felt in every home, and met with all that public recognition and honor which academies and societies are able to bestow. It is a pleasant thought that this great and successful man of science had no scientific quarrels to embitter his life, that his character was beyond reproach, that his cup of domestic joy was full, and that everywhere he was loved as much as he was admired. Happily, too, he has left successors to his fame as well as to his name, who may be worthy to wear the mantle which two generations have made resplendent.

Sir William Thompson, in his address before the British Association, said: "A monument to Faraday and a monument to Herschel Britain must have. The nation will not be satisfied with anything, however splendid, done by private subscription." Whatever other monument Herschel may have, let that most appropriate one be forever guarded and preserved, which he himself chose in honoring his father, when, on January 1, 1840, he, and his wife, and children, and servants, assembled around the dismantled and prostrate telescope which had astonished the world, sang a requiem, which he composed, inside of the tube, and then hermetically sealed it.

MOSES ASHLEY CURTIS was born in Stockbridge, Massachusetts, on the 11th of May, 1808. His father was the Rev. Jared Curtis, of Stockbridge, afterwards for many years chaplain of the State Prison at Charlestown. His mother was a daughter of General Moses Ashley. He was fitted for college chiefly under his father's tuition, and was graduated at Williams in the class of 1827. Three years afterward, he went to Wilmington, North Carolina, as a tutor in the family of Governor Dudley, while at the same time he studied divinity. There he resided until the year 1841, with the exception of a year and a half passed with his father in Charlestown. In the autumn of 1834, he married Miss De Rosset, of Wilmington, who survives him. He took holy orders at Richmond, Virginia, in the summer of 1835; became rector of the Protestant Episcopal Church at Hillsborough, North Carolina, in 1841, and fulfilled the duties of this station for the remainder of his life, with the exception of ten years, from 1847 to 1857, during which he had the pastoral charge of a parish at Society Hill, South Carolina. The degree of Doctor of Divinity was conferred on him by the University of North Carolina, at Chapel Hill. His health for a few years past was sensibly impaired; but he was able to perform his professional duties, and, in a measure, to prosecute his scientific studies, until the 10th of April last, when he died suddenly, probably of heart disease.

Dr. Curtis's attention must have early been attracted to botany, and his predilection fixed by his residence at Wilmington, one of the richest and most remarkable botanical stations in the United States. For it was in the year 1834, after only three years' residence there, that he communicated to the Boston Society of Natural History his first botanical work, namely, his "Enumeration of Plants growing spontaneously around Wilmington, North Carolina, with Remarks on some New and Obscure Species." This was printed in the first volume and second number of that Society's Journal; but the original impression having been mainly destroyed by fire, important additions and emendations were made in the subsequent reprint. The author's powers of observation and aptitude for research are well shown in this publication, and it is one of the earliest of the kind in this country in which the names of the genera and species are accented. In his note upon the structure of Dionæa, or Venus's Fly-trap, — a plant found only in the district around Wilmington, — Dr. Curtis corrected the account of the mode of its wonderful action which had prevailed since the time of Linnæus, and confirmed the statement and inferences of the first scientific describer, Ellis, namely, that this plant not only captures insects, but consumes them, enveloping them in a mucilaginous fluid which appears to act as a solvent. Extending his botanical observations to the western borders of his adopted State, Dr. Curtis was among the first to retrace the steps and rediscover the plants found and published by the elder Michaux, in the higher Alleghany Mountains. But for the last twenty-five years, his scientific studies were mainly given to mycology, in which he became a proficient and the highest American authority. His papers upon Fungi, some of which are large, and all important, were mainly published by the American Philosophical Society, and by the Linnean Society of London. Several of them are the joint productions of Dr. Curtis and of the able English mycologist, Mr. Berkeley. His other published writings mainly are "A Commentary on the Natural History of Dr. Hawks's 'History of North Carolina,'" — a good specimen of his appreciation of exact research, and sharpness of wit wholly free of acerbity; two papers in "Silliman's Journal" on "New and Rare Plants of the Carolinas"; and the botanical portion of the "Geological and Natural History Survey of North Carolina," in two parts; — the first, a popular account of the trees and shrubs, issued in 1860; the other, a catalogue of all the plants of the State, in 1867. This includes the lower Cryptogamia, especially the Fungi, of which he enumerates almost 2,400 species, while the Phænogamous plants are less than 1,900. All our associate's work was marked by ability and conscientiousness. With a just appreciation both of the needs of the science and of what he could best do under the circumstances, when he had exhausted the limited field in Phænogamous Botany within his reach he entered upon the inexhaustible ground of Mycology, which had been neglected in this country since the time of Schweinitz. In this difficult department he investigated and published a large number of new species, as well as determined the old ones, and amassed an ample collection, the preservation of which is most important, comprising as it does the specimens, drawings, and original notes which are to authenticate his work. By his unremitting and well-directed labors, filling the intervals of an honored and faithful professional life, he has richly earned the gratitude of the present and ensuing generations of botanists. Several years ago he prepared drawings of the edible Fungi of the country, with a view to making them better known in an accessible and popular publication; but he was unable to find a publisher. He was much impressed with their importance as a source of food. During the hardships of the Rebellion, he turned his knowledge of them to useful account for his family and neighborhood; and he declared that he could have supported a regiment upon excellent and delicious food which was wasting in the fields and woods around him.

JOHN EDWARDS HOLBROOK was born in Beaufort, South Carolina, on the 31st of December, 1796. He spent his childhood in Wrentham, Massachusetts, the home of his father. He graduated at Brown University, subsequently studied medicine in Philadelphia, and completed his scientific education at the Medical School of Edinburgh. He travelled extensively on the Continent, making himself thoroughly familiar with everything pertaining to his profession. In 1822, he returned to America, and established himself in Charleston, where he was appointed to the Professorship of Anatomy in the Medical School; — a post he occupied for over thirty years. In 1827, he married Miss Harriet Rutledge, who assisted and encouraged him in all his scientific pursuits. Her remarkable social and intellectual qualities endeared her to a large circle of friends, who will ever gratefully remember the hospitalities of Belmont and the kindness of the host and hostess.

In the midst of his professional duties he found time to devote to investigations of Natural History, his volumes on the "Herpetology of the United States" being perhaps one of the first publications to attract the attention of European scientific men to the progress of the natural sciences in the United States. The naturalists of the present day cannot be too grateful to him for having produced a work which at the time not only had no equal in Europe in its special department, but will remain hereafter the standard work, and the basis for all subsequent works on the subject in this country; although at the time of its publication the difficulties which beset an author, in the way of want of libraries, total absence of scientific tradition, and lack of accurately determined material, can hardly be appreciated by the naturalists of the present time, with their daily increasing facilities for study and comparison. These difficulties only a true love of his science could have surmounted; and the example given by Dr. Holbrook will long be beneficially felt throughout the country.

After the completion of his "Herpetology" he visited Europe again, and renewed the relations he had formed before with the scientific men abroad, more especially with the professors of the *Jardin des Plantes*.

On the breaking out of the war, he was engaged upon his "Ichthyology of South Carolina," for which the State of South Carolina had given him a moderate grant to defray a part of the expenses. The first edition was nearly completely destroyed by a fire in Philadelphia, and the war put an end to all further work. It is thus unfortunately left incomplete. During the war he served as a physician in the Southern army, and in spite of his old age was often compelled to share the rations and be exposed to the hardships of the common soldier. At the close of the struggle he was among the first who were willing to make all reasonable concessions for the restoration of peace, and who returned with unimpaired affection to his Northern friends, although the result had involved him in the common ruin.

For the last years of his life he spent the summers in New England. He died on the 8th of September, 1871, at Norfolk, Massachusetts, at his sister's residence, in the village where he had spent his infancy and boyhood, surrounded by his family and friends.

DENNIS HART MAHAN was born April 2, 1802, in the city of New York. His boyhood was passed in Norfolk, Virginia. While pursuing the study of medicine with Dr. Archer, in Richmond, Virginia, he received in 1820, through the influence of Hon. Thomas Newton, of the United States House of Representatives, an appointment as cadet at the United States Military Academy. Entering the Academy at the age of eighteen, he at once became the marked man of his class, and took the foremost rank. While only a third-classman, he was appointed acting assistant professor of mathematics On July 1, 1824, he graduated at the head of his class, and entered the corps of engineers of the army. He continued attached to this corps, with the rank of second lieutenant of engineers, until January 1, 1832, but saw no actual service, being always on detached duty. From 1824 to 1826, he was serving at the Military Academy; the first year, as assistant professor of mathematics, the second, as principal assistant professor of engineering. The next four years, from August, 1826, to June, 1830, were spent in Europe, on professional duty, by order of the War Department. During the last year of this sojourn in Europe, he was, by authority of the French Minister of War, attached as a pupil to the military school of artillerists and engineers at Metz. At that time there was no other place or school which could give that special training which so thoroughly fitted him for the duties to which he was to be called immediately upon his return to his own country. Metz, with all the glories of its historic renown as the bulwark of France, was also the thorough exemplification of the best systems of fortification devised by the genius of Vauban and Cormontaigne; and here, if anywhere, the earnest student would become thoroughly impressed with the love of his art, and initiated into all its mysteries. Mahan, on his return home, was at once appointed acting professor of engineering at the Military Academy, and finally, in 1832, was appointed professor, — a post which he filled with distinguished honor until his death on the 16th September, 1871.

In order to appreciate the full influence of his character and attainments in this position, we must go back to the period when he assumed its duties, and see what was the state of engineering science at the time. The student of the present day will find it hard to realize what the actual state of knowledge then was. Professional books were rare, and hardly existed except in foreign languages; and the number of those who had the desire and ability to consult them was still rarer. Military engineering was a meagre conglomeration of a few detached practices rather than principles; and civil engineering, not having yet received the impetus which the railroad system has since given it, could hardly be said to have an existence as a science. It became necessary for Mahan to create his own text-books; and even as late as 1842, when the writer was a pupil under him, these text-books were, in many cases, lithographic notes prepared at the presses of the Academy, and lent to the students for their instruction. The whole subject of permanent fortification and stereotomy was thus taught, and there were no American books upon the subject existing at that time. Even in the more elementary descriptive geometry the only American book was by a professor at the Military Academy, and this omits entirely the "*Théorie des plans côtés*, which forms the basis of fortification drawing.

But Mahan was one of those rare men who teach more by their personality than by their books. While it is true that he created books, and books which, though pioneers in their day, stand the test of comparison with the best works of later explorers, it is equally true that those who were so fortunate as to sit under his instruction learned much more than the books ever revealed. In the magic power of his personal communication with the pupil lay the great secret of his success as a teacher. The pupil who came under his searching eye felt that all shams were useless, that anything like pretension was at once exposed and rebuked, while true, honest effort always met with a cordial and hearty response, and found all the aids which it sought. The writer had the privilege of being not only his pupil, but, at a later period, his principal assistant; and in this latter capacity he learned to know the value of this great teacher. With a nature peculiarly sensitive, and a very nervous organization, Mahan had so schooled himself that he had become truly judicial in his estimate of whatever was presented to him. With a genuine love of science in any of its developments, he had naturally that instinctive abhorrence of charlatanry in its multiform manifestations, and that unsparing sarcasm ever ready for its exhibition, which led those who did not know him to regard him as cynical and morose. But none who had the honor of his friendship ever looked at him in this guise. To them he was the true, warm-hearted friend, to whose ready sympathy in everything that was right and honest they would appeal without hesitation; but whom, on the contrary, they would dread to approach with any proposition of doubtful or even questionable probity. Though small of stature and thin of frame, Mahan had ever a commanding presence, before which presumption and arrogance felt rebuked; and this personality made itself felt by even the most turbulent spirits in his classes. His effect in this way, even upon those who were not qualified to directly appreciate his instruction, made no small part of his influence as a professor in our Military Academy.

But Mahan's influence and the value of his life are not confined to the immediate scene of his labors. By his occasional writings, and by those of his published works which are less distinctly professional, he has stimulated the public mind in a much wider sphere. His work on civil engineering, which has gone through several editions, and been several times revised and almost rewritten by its author since its first publication, is still one of the best compendiums on the subject. His edition of Moseley's "Mechanics of Engineering," with its valuable additions and annotations, has brought to the notice of the American public one of the very best English works. During our late war, his work on field fortifications — the best work on that subject in any language — and his minor work on outpost duty were in the hands of all of our militia officers who sought instruction in their duties. Science and education owe much to the labors of his long life, and the memory of that life will be preserved in the many works which he has left behind him. Brown and Princeton conferred upon him the honorary degree of A. M. in 1837, and he subsequently received that of LL. D. from William and Mary, Brown, and Dartmouth. In 1828, he was elected a member of the Geographical Society of France. He was a member of several scientific societies in this country, and one of the original fifty corporators of the National Academy of Science.

To the interests of the Military Academy Mahan devoted the best energies of his life. Regarding it not merely as a school of military science, but as it really was, for a long period, the only scientific school worthy of the name in our country, his whole thoughts were given to the advancement of its prosperity; and, as one of its Faculty, he jealously watched every change in its educational system which tended to lower its high standard. Especially, in all the assaults which are periodically made upon it, was he found ever ready, by voice and pen, to repel those assaults, and vindicate the fair reputation of his Alma Mater. No one could do this better than he. With a thorough conviction of the honesty of his cause, and a mind well stored with historical knowledge, he combined a ready command of language and a trenchant satire never exceeding proper bounds, which made every essay from his pen, and, still more, every word from his mouth, produce its effect. The Military Academy has lost by his death, not only one of its ablest workers, but also one of its strongest and most fearless champions.

Soon after the last annual examination of cadets, the rumor became prevalent that, by the recommendation of the Board of Visitors, this aged professor, now in his seventieth year, was to be removed from active duty at the Academy, and placed upon the retired list. Though on the score of years, and under the usage of the military service, he might have claimed this as his right, this unlooked-for action of the Board came to him, not as a measure of relief from arduous duty, but as a vital assault upon his life-long work and reputation. The shock was too great for him to bear; and when he returned to his post in September, after the usual summer season of relaxation, it was but too evident that his sensitive brain had received a fatal blow. On the 16th of September he left West Point, with an attendant, by the steamer Mary Powell, for the purpose of consulting his physician in New York. When the boat was near Stony Point, he passed rapidly out of the saloon where he had been sitting, and rushing to the side of the boat, just in front of the wheel, he disappeared beneath the waters of the Hudson. Thus ended the life of this most distinguished son of our Military Academy, one of the ablest expounders of engineering science, one of the most zealous, judicious, and successful workers in the cause of education.

Samuel Finley Breeze Morse died at his residence in the city of New York on the 4th of April, 1872.

He was born in Charlestown, Massachusetts, April 27, 1791. He was the eldest son of Jedediah Morse, D. D., an American clergyman and geographer, who was for thirty-one years pastor of the First Congregational Church in Charlestown.

Mr. Morse was a graduate of Yale College, in the class of 1810. He went to Europe during the next year, making the voyage with Washington Allston, and became a pupil, in painting, of Benjamin West.

In addition to his studies in painting, he gave attention to sculpture, and in 1813 received the gold medal of the Adelphi Society of Arts, for an original model of a "Dying Hercules."

He returned to the United States in 1815. In 1824–25, with some other artists of New York, he originated a drawing association, which resulted in the establishment, a year later, of the "National Academy of Design." He held the office of President of this society for fifteen years.

In 1829, he again visited Europe, to complete his studies in art, and resided, about three years, in the principal cities of the Continent.

On the return voyage from France, in 1832, on the ship Sully, the feasibility of an electric telegraph was often the subject of conversation, and at that time he made drawings of apparatus intended for this purpose. His first instrument was finished at New York in 1835, and worked in one direction. In July, 1837, he had two instruments, one at each terminus, and could communicate in both directions.

At the close of that year he was at Washington, a petitioner to Congress for aid to construct an experimental line from that city to Baltimore. No appropriation was made during the session of 1837–38, and he went again to Europe.

A patent for his system of telegraphing was refused in England; in France, he obtained a *brevet d'invention*, but it proved to be of no value. He returned to the United States, and, after several years of disappointment and poverty, his appeal to Congress was successful,—the sum of thirty thousand dollars being appropriated on the 4th of March, 1843, for the purpose of encouraging his first attempt to construct a line of electric telegraph between Washington and Baltimore, a work which, after many difficulties, he completed in 1844.

This system has now been in use twenty-eight years; its simplicity, as compared with other kinds of electric telegraph, has favored its general introduction both at home and abroad. In this, as in all important inventions, the practical result is reached by long and patient efforts of many minds, in various departments of scientific and mechanical labor. The world is greatly indebted to Mr. Morse for his perseverance and earnest labor in combining the various parts that constitute the present "Electro-magnetic Telegraph."

This system is now found in operation in all quarters of the world, and has, on many land lines, displaced the needle telegraph. It is not of value for the Atlantic cable or other submarine lines, as they are worked, in all cases, without the use of an electro-magnet.

Mr. Morse received many honors and marks of distinction abroad, and from ten foreign governments the sum of four hundred thousand francs as an honorary and personal award for his useful labors.

He was appointed one of the United States Commissioners to visit the Paris Universal Exposition of 1867, and make examination of telegraphic apparatus. His report on this subject was published in 1869.

CHARLES JACKSON, JR., as he always called himself long after his father's death, was the only son of the Hon. Charles Jackson, one of the judges of the Supreme Court of Massachusetts from 1813 to 1823, and Fanny (Cabot) Jackson, his second wife. He was born on the fourth day of March, 1815.

He was fitted for college chiefly at the schools of Mr. Daniel Greenleaf Ingraham and Mr. William Wells. He entered Harvard College at Commencement, in the year 1830, joining the Sophomore Class. Without aiming at college rank, he held a very creditable position as a scholar.

On leaving college, he began the study of the law with his father, and continued it in the office of the Hon. Charles Greely Loring. He was admitted to the Suffolk Bar in 1836. The years 1837 and 1838 he spent in Europe. On his return, he gave his attention to the study of civil engineering, and was employed on the Western and Eastern railroads during the years 1839 and 1840. After 1840, he devoted himself to iron-making, becoming largely interested in mines and furnaces in Pennsylvania, and continued in this business to the close of his life.

From his college days he was recognized as a man of singularly acute and original intellect. He took nothing on trust which he could study out for himself. With an ever-active thirst for knowledge, a marvellous rapidity and accuracy in acquiring information, and a memory so remarkable that some almost incredible feats are told of it, he was less generally known than many men much his inferiors who care more for fame or notoriety. He was full of knowledge on a great variety of subjects, and talked with an affluence of expression and a knowledge of facts which always commanded the attention of those around him. His business capacity was remarkable, and though he had some trying experiences early in his career, his indomitable courage and clear, cool head carried him safely through them all, and brought his extensive plans to a complete and eminently successful fulfilment.

Mr. Jackson very rarely appeared before the public in any other light than as a man of business. He wrote as he talked, with a facility and rapidity and fertility very rarely equalled, as many of his letters remain to show, — letters as impetuous, as ingenious, as close in argument, as vivid in illustration, as if they were verbatim reports of his brilliant conversation. But I am not sure that he ever printed more than one paper, or delivered more than a single lecture.

In the "North American Review" for October, 1852, is a paper written by him on the subject of the Great Exhibition. It is a very spirited essay, taking the side of the practical workman as an inventor against the pretensions of the man of science. All the characteristics of his mind are very well represented in this essay, which can be read to-day with as much instruction and entertainment as when it was written. He may have pressed his argument at some points, but it is a very striking plea for the discoveries and inventions of the workshop as against those of the laboratory.

In the winter of 1853-54, Mr. Jackson delivered a lecture, in the course instituted by the Academy, on the "History of the Useful Arts." This lecture was distinguished by the same qualities which characterized the essay in the "North American Review." Some of its conclusions were startling; but, if not proved, they were supported by such an array of facts, so ingeniously presented, as to offer a formidable front to an opponent. Most of the inventions claimed by Englishmen, as I remember this lecture, were proved or alleged, with a greater or less show of evidence, not to have come from men of Anglo-Saxon birth, that particular stock never having distinguished itself by inventive talent. The lecture was listened to with great interest, and some of its conclusions were, I think, controverted; but it was an effort which showed the keen iconoclastic radicalism of his intellect in its fullest development.

Mr. Jackson's personal character, his fidelity in friendship, the warmth of his attachments, his generous hospitality, added to the attractions of his companionship, made him a great favorite with those who enjoyed the privilege of his intimate acquaintance.

He died, after a protracted illness, on the 30th of July, 1871, leaving a widow and three children, two sons and a daughter. His eldest daughter, the wife of the Rev. George Folsom, died one month before her father.

JAMES DAVENPORT WHELPLEY was born in the city of New York, January 23, 1817, and died in Boston, April 15, 1872. His father, Philip Melancthon Whelpley, was pastor of the First Presbyterian Church in New York City. His grandfather was the Rev. Samuel Whelpley, a distinguished writer and theologian. His mother was Abigail Fitch Davenport, a granddaughter of the Rev. John Davenport, one of the founders of the New Haven colony. He was sent to school at New Haven, where, at an early age, he showed a decided taste for chemical study and experimentation. He entered Yale College in 1833, and was graduated in 1837. In his Senior year he published in the "American Journal of Science" a paper "On two American Species of the Genus Hydrachna," in conjunction with Mr. J. D. Dana, then assistant to Professor Silliman.

Soon after leaving college he joined the corps of Professor Henry D. Rogers, then occupied in surveying the anthracite region of Pennsylvania. After three years' service upon this survey, he studied at the Medical School in Pittsfield, Massachusetts, and, having received the degree of that school, he practised medicine in Brooklyn, New York, until forced by ill health to relinquish his profession.

He then returned to New Haven, and devoted himself to scientific and literary study for a period of eight years. At this time, he conceived the idea of a Philosophical System, to the development of which he devoted much time and thought. Some fragments of this work have been published in the "Proceedings of the Academy," and elsewhere, and much manuscript matter relating to it remains in the possession of his family. During his residence in New Haven, he published in the "American Journal of Science" (1845) a remarkable memoir on the "Idea of an Atom, suggested by the Phenomena of Weight and Temperature."

In 1847, he went to New York, and became editor and partial owner of the "American Whig Review." In 1849, while occupied in editing the Review, he conceived the idea of establishing a commercial colony in Honduras, for the purpose of developing the resources of that country, and bringing it into closer relations with the United States. He at once proceeded to obtain from the Honduras government grants of land and various commercial privileges, and spent two or three years in San Francisco editing a daily newspaper, which he had purchased there, as a means of making his plan known. He had secured a large number of emigrants, and was engaged in perfecting the arrangements for establishing his colony, when he learned that the filibuster Walker had taken forcible possession of Honduras. Dr. Whelpley immediately left San Francisco with an armed party of fifty men, to protect the interests of his projected colony. But his party was captured by that of Walker, and Dr. Whelpley was himself impressed into Walker's service, and put in charge of the sick and wounded men.

He was detained by Walker for nearly a year, suffering meanwhile great privations. He finally escaped to San Francisco, and thence returned in 1856 to New York, where he supported himself for a time by writing short articles for the magazines upon the most varied subjects, — History, Politics, Music, and Romance, as well as Science. Some of these literary diversions, published in the "Atlantic Monthly," bear witness both to the fluency of his pen and to his extraordinary power of imagination.

Henceforward, in spite of frequent severe attacks of asthma and other pulmonary troubles, and almost incessant physical pain, he devoted much time to the study of mechanics, and the invention of machines for saving labor and fuel. His exceedingly ingenious and efficient devices for crushing and pulverizing rocks and ores, for burning fuel in the state of powder, and for applying the heat of the fuel thus burned to the reduction of metallic ores, and to the generation of steam, are familiar to many members of the Academy. Descriptions of them have been widely published in the journals relating to mechanics and metallurgy.

An ingenious steam-engine of his own invention was exhibited at the Institute of Technology in the winter of 1869 – 70. During the last twenty years of his life he was deeply interested in the study of engines, — hot air, gas, and steam, — and he has left nearly three hundred original designs for their construction. His most recent contribution to scientific literature was a series of articles in Van Nostrand's "Engineering Magazine." The last of these papers, published in January, 1872, was entitled "A Critical Examination of the Ideas of Inertia and Momentum."

Dr. Whelpley was remarkable both for his power of abstract reasoning and for the vivacity and scope of his imagination. His was essentially a deductive and inventive mind. Its chief defect was its immense versatility. By mere power of concentration and force of will, he kept at bay the physical pain and distress incident to the pulmonary disease which harassed his later years. The most severe illness hardly seemed to impair in the least degree the acuteness of his intellect; though, during the last few years of his life, his condition was such that he was compelled to avoid all social intercourse, and to abstain absolutely from discussion. It was a source of deep regret to him, that he could not even attend a meeting of the Academy, much less present or defend his views before it, except under the penalty of great pain and alarming illness. From a final attack of this kind was developed the acute consumption of which he died. Dr. Whelpley was a man of rare conversational powers and ready wit, and he had a great fund of information in matters relating to literature and the arts and sciences. He possessed, moreover, in a marked degree, the power of attracting to himself devoted friends. He was esteemed by those who knew him intimately to be a high-minded, honorable gentleman, of warm impulses and attachments, and generous and self-sacrificing to a fault.

Six hundred and forty-seventh Meeting.

September 10, 1872. — STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Professor Jowett, of Oxford, and Professor Rammelsberg, of Berlin, acknowledging their election into the Academy.

The President announced the death of M. Delaunay, Foreign Honorary Member, and of General Sylvanus Thayer.

The President called attention to a bound volume of several articles, in manuscript, of Count Rumford, presented by Professor Dumas to the Library of the Academy.

It was voted that the thanks of the Academy be tendered to Professor Dumas for this most acceptable donation.

The President called attention to the loss the Academy had sustained in the death of Dr. Francis Dana, for many years Assistant Librarian.

Six hundred and forty-eighth Meeting.

October 9, 1872. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

The President announced the death of Professor Francis Lieber, of New York, Associate Fellow of the Academy.

Professor J. P. Cooke read the Annual Report of the Rumford Committee, and, in accordance with its suggestion, it was voted to appropriate one thousand dollars to continue the publication of the works of Count Rumford.

On the motion of the Treasurer, it was voted to appropriate:

For General Expenses	$ 2,100.00
For Publication	800.00
For Library	500.00

It was voted to authorize the officers of the Academy to reserve two hundred and fifty copies of the Life and Works of Count Rumford, to be preserved intact until the completion of the Works.

It was voted to authorize the officers of the Academy to distribute freely the Life and first volume of the Works of Count Rumford among learned societies and scientific men.

It was voted to authorize the Rumford Committee to complete the stereotyped plates, and print a small edition of the second volume of the Works of Count Rumford.

Professor T. S. Hunt presented a communication on the formation of agates in the Lake Superior region.

Professor W. A. Rogers described some experiments he had been making in etching fine lines on glass.

The President called attention to a copy of the work on the "Physiological and Therapeutical Action of the Bromides of Potassium and Ammonium," by Drs. E. H. Clarke and R. Amory.

Six hundred and forty-ninth Meeting.

November 12, 1872. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from Sir William Thomson, acknowledging his election into the Academy.

The President announced the death of General George G. Meade, Associate Fellow, and of Mr. Charles Folsom, Resident Fellow, of the Academy.

The Recording Secretary was authorized to send reports of the meetings of the Academy to the editor of "Nature," for insertion in that journal.

Mr. S. P. Sharples presented a communication on the comparative purity of various sources of water-supply in the neighborhood of Boston.

Six hundred and fiftieth Meeting.

November 27, 1872. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from Mr. Sang, enclosing specimen pages of a table of logarithms to nine places, which was referred to the Recording Secretary.

The President announced the death of Professor James Hadley, of New Haven, Associate Fellow of the Academy in Class III., Section 4.

The following gentlemen were then elected Resident Fellows of the Academy: —

Professor W. R. Nichols, of Boston, to be a Resident Fellow in Class I., Section 3.

Professor C. L. Jackson, of Cambridge, to be a Resident Fellow in Class I., Section 3.

Professor C. O. Boutelle, of Cambridge, to be a Resident Fellow in Class I., Section 4.

Mr. J. M. Merrick, of Boston, to be a Resident Fellow in Class I., Section 3.

Mr. N. St. J. Green, of Cambridge, to be a Resident Fellow in Class III., Section 1.

It was voted to appoint a Committee on Communications, consisting of Professor James M. Crafts, Dr. E. H. Clarke, Professor A. Agassiz, and the Recording Secretary.

Professor A. Agassiz presented a communication on the development of *Balanoglossus*.

Professor T. S. Hunt made a communication on a paper by Mr. Mallet on the cause of volcanic activity.

Dr. Henry I. Bowditch alluded to a case of aortic aneurism in which he had, with the assistance of Drs. J. C. Warren and J. J. Putnam, used electricity for the treatment of this usually fatal disease.

The patient, an adult man, had a pulsation distinctly felt in the second right intercostal space, which last, with the parts adjacent, was slightly prominent, but not effaced. The respiratory murmur was free throughout both lungs, save in this part, and there it was bronchial to the extent of two or three inches; dull percussion in the same. Two operations have been made, namely, on November 12 and 17, 1872. Three needles coated with vulcanite were used at each operation. They were introduced about an inch at the first, and from an inch and a quarter to an inch and a half at the second operation. They evidently were introduced into a freely moving current at the first, as seen by the widely moving needle-ends, but into a more solid mass at the second. The positive pole of the battery *alone* was applied to them, the negative resting on the right breast on a level with the tumor. The number of cells used (Stöhrer's battery) were gradually raised from two up to sixteen at the first, and to twenty-eight at the second. The operations lasted fourteen and a half and fourteen minutes. A little faintness and pulselessness were noticed at the termination of each. They soon passed away. The result of the two operations has been a great solidity of the tumor, with considerable swelling of parts adjacent, which swelling is now (November 26) subsiding. No superficial redness or sloughing of the skin occurred. No air appeared in the tumor, as noticed often in Europe, where needles attached to *both* poles are usually introduced (*Vid. Ciniselli Annali di Medicina,* November, 1870; *Frazer's Edinburgh Medical and Surgical Journal,* August, 1867). The patient has not suffered at all from the operations. It is impossible, as yet, to say what influence they will have towards his radical cure. But he is more comfortable than before the first operation.

Six hundred and fifty-first Meeting.

December 10, 1872. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Professor

Nicholas St. John Green, and from Professor William Ripley Nichols, acknowledging their election into the Academy.

It was voted to grant the use of the Hall of the Academy on the morning of Thursday, December 12, to the Massachusetts Historical Society.

The President called the attention of the Academy to a volume richly illustrated, entitled "Revision of the Echini," by Alexander Agassiz.

Alexander Agassiz then exhibited specimens of the Albertype and Woodburytype methods of photo-engraving employed in illustrating his work.

The Recording Secretary exhibited a new form of Theodolite-Magnetometer.

A letter was then read from Dr. Robert Amory, describing some specimens of objects exposed to the fire of November 9, which led to a discussion in which most of the members present participated.

Six hundred and fifty-second Meeting.

January 14, 1873. — MONTHLY MEETING.

The CORRESPONDING SECRETARY in the chair.

The Corresponding Secretary read a letter from Professor Döllen, of Pulkowa, acknowledging his election, as Foreign Honorary Member, into the Academy.

Professor J. M. Peirce read the following paper by Professor J. M. Rice of Annapolis, and Professor W. W. Johnson of St. John's College, Maryland, "On a New Method of obtaining the Differentials of Functions, with especial reference to the Newtonian Conception of Rates or Velocities."

The fundamental conceptions which have been employed in the development of the elementary theorems of the Differential Calculus are four in number, namely, that of *Infinitesimal Differences*, that of *Limits*, that of *Derived Functions*, and that of *Rates* or *Fluxions*.

While the first and more recently the second have received greater attention and more systematic development, the last, the Conception of Rates, has an important advantage in the readiness with which its definition is apprehended in consequence of the familiarity of the phenomena of motion.*

The most important objections which have been made to the "Method of Fluxions," as developed by Newton and his followers, are those directed against the methods employed in deducing the fluxions of the different functions. These are usually geometrical methods, often indirect and wanting in generality, even when founded upon well-known and satisfactorily demonstrated properties. The algebraic methods, also, which are employed, are frequently dependent upon an objectionable use of infinite series.

While a *constant rate* is easily measured by the increment received in a unit of time, a difficulty is encountered when an attempt is made to employ increments in the measurement of a *variable rate*. This difficulty probably gave rise to the common method, in which a comparison of rates is effected by the conception of simultaneous infinitesimal increments; to these, while divested of magnitude, ratios are ascribed which are really the ratios of the rates of quantities simultaneously varying.

The method of limits is another device for obtaining the values of the same ratios.

This last expedient, having been adopted by Maclaurin (perhaps the ablest writer on Fluxions), the impression has become prevalent that recourse to it affords the only satisfactory method of treating the subject of rates.

The following is an attempt to supply a direct method of proving the elementary theorems of the Differential Calculus, which is independent of all consideration of limits, of infinitesimals, and of algebraic series.

DEFINITIONS AND NOTATION.

When a quantity varies uniformly, the constant numerical measure of its rate is the increment received in the unit of time. When, however, the variation is not uniform, we would define the numerical measure of the rate at any instant as the increment which would be received in a unit of time, if the rate remained uniform from and after the given instant.

This definition corresponds with the usage of mechanics, in accordance with which a body moving with a variable velocity is said to have at a given instant a velocity which would carry it thirty-two feet in one second.

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* See Art. 42, p. 72, *Traité élémentaire de la Théorie des Fonctions et du Calcul Infinitésimal.* Par COURNOT. Paris, 1841.

To avoid departing too much from well-established usage, the term *differential* will be frequently used in this paper instead of *rate.*

The *rate* or *differential* of x will be denoted by Dx, and that of f, x by $D(f, x)$.

The rate of the independent variable, or the value of Dx, is regarded as arbitrary in the same sense that the value of x is arbitrary.

Thus, particular values of these two quantities may constitute the data of a question like the following: What is the value of $D(x^2)$, when x has the value 10 and Dx the value 4?

To differentiate a function of x is to express $D(f, x)$ in terms of x and Dx in such a manner as to furnish a general formula by which $D(f, x)$ may be computed for any given values of x and of Dx.

Elementary Propositions.

The following propositions are immediate deductions from the above method of measuring rates: —

I. *The Differential of* $x + h$.

Since any simultaneous increments of x and of $x + h$ must be identical, the increments which would be received by each, if they continued to vary uniformly with the rates denoted by Dx and $D(x + h)$, are equal. Hence the rates are equal, or

$$D(x + h) = Dx.$$

II. *The Differential of* $x + y$.

Since any increment of $x + y$ is the sum of the simultaneous increments of x and of y, the same relation exists between the increments which would be received if x and y (and consequently $x + y$) continued to vary uniformly with the rates denoted by Dx, Dy, and $D(x + y)$. Hence

$$D(x + y) = Dx + Dy.$$

III. *The Differential of* mx.

Since any increment of mx must be m times the corresponding increment of x, the same relation must exist between the increments which would be received if x (and consequently $m x$) continued to vary uniformly with the rates denoted by $D(x)$ and $D(m x)$. Therefore

$$D(m x) = m D x.$$

THE RATIO OF THE RATES OF A VARIABLE AND ITS FUNCTION.

Let y denote a linear function of x such that

$$y = m x + b. \qquad [1]$$

By propositions I. and III.

$$D y = m D x,$$

or

$$\frac{D y}{D x} = m. \qquad [2]$$

In this case, the ratio of the rate, or differential, of the function to that of the independent variable is constant, its value being independent not only of x, but also of $D x$. Thus, if we give to $D x$ any arbitrary value, it is evident from equation [2], that $D y$ must take a corresponding value such that the ratio of these quantities shall always retain the constant value m.

Assuming rectangular co-ordinate axes, if y be made the ordinate corresponding to x as an abscissa, the point (x, y) will, as x varies, generate a straight line. The direction of the motion of the point is constant, and depends upon the value of m. Since $\frac{D y}{D x}$ is equal to m, it is the trigonometrical tangent of the constant inclination of the direction of the generating point to the axis of x.

When y is not a linear function of x, the direction of the motion of the generating point is variable, and consequently the value of $\frac{D y}{D x}$ is variable.

Making, now, the arbitrary quantity $D x$ a constant, $D y$ will be a variable. Suppose, then, that, the generatrix having arrived at a given point, the ordinate y continues to vary uniformly with the rate denoted by $D y$ at the given point; the value of $\frac{D y}{D x}$ will become constant. The generatrix will now continue to move uniformly in the direction of the curve at the given point, and therefore the value which $\frac{D y}{D x}$ has at this point is that of the trigonometrical tangent of the inclination of the curve to the axis of x at this point. The line *now* described by the generatrix is called a tangent line to the curve, in accordance with the following general definition: The tangent line to a curve at a given point is the line passing through the point, and having the direction of the curve at that point.

IV. *The Ratio of the Rates is independent of their Absolute Values.*

Since the direction of the curve (or of the tangent line) at the point having a given abscissa is determined by the form of the function, or equation, to the curve, the value of $\frac{Dy}{Dx}$, which is the trigonometrical tangent to the inclination of this direction, must be independent of the arbitrary quantity Dx, which merely determines the velocity of the generating point.

In general, the value of $\frac{D(f, x)}{Dx}$ will change with that of x; $\frac{D(f, x)}{Dx}$ is, therefore, independent of Dx, but is generally a function of x.

$D(f, x)$, when expressed in terms of x and of Dx, is of the form

$$D(f, x) = \phi x \,.\, Dx$$

in which ϕx is another function of x.

In the ordinary methods, the introduction of an equivalent proposition is, for the most part, avoided by rejecting from the ultimate value of $\Delta(f, x)$ all terms containing powers of Δx higher than the first.

We shall now proceed to deduce, from the four elementary propositions hitherto proved, the differentials of the functions both algebraic and transcendental. These propositions are here recapitulated for convenience of reference:—

I. $D(x + h) = Dx.$

II. $D(x + y) = Dx + Dy.$

III. $D(mx) = m\,Dx.$

IV. $\frac{D(f, x)}{Dx}$ is independent of Dx, but is generally a function of x.

THE DIFFERENTIAL OF THE SQUARE.

Let $z = x + h$, then $Dz = Dx$, [1]

and $z^2 = x^2 + 2hx + h^2$, and $D(z^2) = D(x^2) + 2h\,Dx$. [2]

Dividing [2] by [1], $\frac{D(z^2)}{Dz} = \frac{D(x^2)}{Dx} + 2h$, and since $h = z - x$,

$$\frac{D(z^2)}{Dz} - 2z = \frac{D(x^2)}{Dx} - 2x. \qquad [3]$$

Since $\frac{D(z^2)}{Dz}$ is a function of z only, and $\frac{D(x^2)}{Dx}$ a function of x only, while z and x are any two values of the independent variable (h being arbitrary), the functional expression which constitutes either member of equation [3] does not change its value with the independent variable, hence

$$\frac{D(x^2)}{Dx} - 2x = c \text{ (a constant)}, \qquad [4]$$

or

$$D(x^2) = 2x\,Dx + c\,Dx. \qquad [5]$$

To determine the unknown constant c, we differentiate, by equation [5], the identity

$$(mx)^2 = m^2 x^2,$$

obtaining

$$2mx \cdot m\,Dx + c\,m\,Dx = m^2\,2x\,Dx + m^2 c\,Dx,$$

or

$$c\,m\,(1 - m)\,Dx = 0.$$

$$\therefore \qquad c = 0,$$

since m and Dx have arbitrary values,

$$\therefore \qquad D(x^2) = 2x\,Dx. \qquad [a]$$

Equation [a] may also be deduced from [3] by the following method:—

In equation [3] not only are x and z entirely independent, since h is arbitrary, but Dx and Dz are no longer restricted, for $\frac{D(z^2)}{Dz}$ will not change its value if we suppose Dz to have any value greater or less than Dx. We may therefore put

$$z = mx.$$

Introducing this value in [3], we obtain

$$\frac{D(m^2 x^2)}{D(mx)} - 2mx = \frac{D(x^2)}{Dx} - 2x,$$

or

$$m\frac{D(x^2)}{Dx} - 2mx = \frac{D(x^2)}{Dx} - 2x;$$

$$\therefore \qquad (m-1)\frac{D(x^2)}{Dx} = (m-1)\,2x.$$

Whence, since m is arbitrary,

$$\frac{D(x^2)}{Dx} = 2x.$$

The process used in the case of those functions whose differentials it is desirable to deduce independently is, in each instance, similar to that used above in the case of $D\,(x^2)$, and may be thus described: —

We assume a new variable z, connected with x by a relation admitting of a comparison of $D\,z$ and $D\,x$, and at the same time such, that $D\,(f, z)$ and $D\,(f, x)$ may likewise be compared; in other words, such that the relation between z and x, and also between f, z and f, x, can be differentiated without the introduction of unknown differentials, except those denoted by $D\,(f, x)$ and $D\,(f, z)$.

By division, the ratios $\frac{D\,(f, x)}{D\,x}$ and $\frac{D\,(f, z)}{D\,z}$ are introduced in a single equation. The arbitrary constant introduced in the assumed relation between z and x is then eliminated, and the equation reduced to such a form that one member is apparently a function of z, and the other of x. This last process we call the *separation of the variables.*

As x and z may denote any two values of the independent variable, the apparent functions mentioned above will necessarily be identical in form, and (since they constitute the two members of an equation) identical also in value. This value will be constant, since either member of the equation is a functional expression, which does not change its value with x.

The determination of this constant is then effected by the differentiation of some algebraic identity.

THE DIFFERENTIAL OF THE PRODUCT.

From the above expression for $D\,(x^2)$, we obtain the Differential of the Product, thus: —

$$(x+y)^2 = x^2 + 2\,x\,y + y^2.$$

$$\therefore \quad 2\,(x+y)\,(D\,x + D\,y) = 2\,x\,D\,x + 2\,D\,(x\,y) + 2\,y\,D\,y,$$

$$\text{or} \quad x\,D\,x + y\,D\,x + x\,D\,y + y\,D\,y = x\,D\,x + D\,(x\,y) + y\,D\,y,$$

$$\therefore \quad D\,(x\,y) = y\,D\,x + x\,D\,y.^{*} \qquad [b]$$

From this result the *Differential of the Quotient* is easily obtained.

THE DIFFERENTIAL OF THE POWER.

Let $z = r\,x$, then $D\,z = r\,D\,x$, [1]

and $z^m = r^m\,x^m$, then $D\,(z^m) = r^m\,D\,(x^m)$, [2]

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[*] This method of deriving $D\,(x\,y)$ from (Dx^2) is taken from *Vince's Fluxions.*

Dividing [2] by [1], $\frac{D(z^m)}{Dz} = r^m \frac{D(x^m)}{r\,Dx}$,

and, since $r = \frac{z}{x}$, $\frac{D(z^m)}{Dz} = \frac{z^{m-1}}{x^{m-1}} \frac{D(x^m)}{Dx}$.

Separating variables, by dividing by z^{m-1},

$$\frac{1}{z^{m-1}} \frac{D(z^m)}{Dz} = \frac{1}{x^{m-1}} \frac{D(x^m)}{Dx}. \qquad [3]$$

By a train of reasoning precisely similar to that employed in obtaining equation [4] of the article on $D(x^2)$

we prove $\frac{1}{x^{m-1}} \frac{D(x^m)}{Dx} = C_m$ [4]

C_m being used to denote the constant, because it may be a function of m.

From [4] $D(x^m) = C_m\, x^{m-1}\, Dx$. [1]

By similar notation $D(x^n) = C_n\, x^{n-1}\, Dx$,

and $D(x^{m+n}) = C_{m+n}\, x^{m+n-1}\, Dx$.

To determine C_m.

If $m = 1$ in equation [1] $Dx^1 = C_1\, x^0\, Dx$

$\therefore$ $C_1 = 1$. [2]

Differentiating the identity

$$x^{m+n} = x^m\, x^n,$$

$$C_{m+n}\, x^{m+n-1}\, Dx = x^n\, C_m\, x^{m-1}\, Dx + x^m\, C_n\, x^{n-1}\, Dx,$$

and dividing by $x^{m+n-1}\, Dx$,

$$C_{m+n} = C_m + C_n, \qquad [3]$$

making $m = n$ $C_{2n} = 2\, C_n$,

making $m = 2n$ $C_{3n} = 3\, C_n$, &c.

$\therefore$ $C_{pn} = p\, C_n$; (p being a positive integer). [4]

Making $n = 1$ in [4], $C_p = p\, C_1 = p$. [5]

Again, in [4], putting $n = \frac{q}{p}$, q and p being positive integers,

$$p\, C_{\frac{q}{p}} = C_q = q\,;$$

whence $$C_{\frac{q}{p}} = \frac{q}{p}. \qquad [6]$$

Again, in [3], making $m = o$,

$$C_o = o,$$

and, making $m = -n$, $$C_n = -C_n,$$

or, making $n = \frac{p}{q}$, $$C_{\frac{p}{q}} = -\frac{p}{q}. \qquad [7]$$

From [6] and [7] we have generally

$$C_m = m,$$

and substituting this value of C_m in [1],

$$D\,(x^m) = m\, x^{m-1}\, D\,x. \qquad [c]$$

The Differential of the Logarithmic Function.

Let $z = m\,x$, then will $D\,z = m\,D\,x$, [1]

and $\log z = \log m + \log x$, and $D\,(\log z) = D\,(\log x)$. [2]

Dividing [2] by [1],

$$\frac{D\,(\log z)}{D\,z} = \frac{D\,(\log x)}{m\,.\,D\,x} = \frac{x}{z}\cdot\frac{D\,(\log.\,x)}{D\,x},$$

since $\frac{1}{m} = \frac{x}{z}$, $\therefore\ z\,\frac{D\,(\log z)}{D\,z} = x\,\frac{D\,(\log x)}{D\,x} = B.$ [3]

B denotes a constant depending upon the base of the system of logarithms. Denoting by b this base, and by $\log_b$ a corresponding logarithm, we have

$$D\,(\log_b x) = \frac{B\cdot D\,x}{x}, \qquad [4]$$

and by similar notation $D\,(\log_a x) = \frac{A\cdot D\,x}{x}$.

A relation between A and B is found by differentiating the identical

equation $$\log_a x = \log_a b\,\log_b x,$$

thus obtaining $$\frac{A\,D\,x}{x} = \log_a b\cdot\frac{B\,D\,x}{x},$$

whence $$A = B\cdot\log_a b = \log_a b^B\,;$$

$\therefore$ $$a^A = b^B.$$

The form of this equation shows that the value of the expression b^B is independent of the value of b; it is, therefore, a numerical constant, and may be denoted by e.

i. e. $$b^B = e;$$

∴ $$B \log_e b = 1,$$

whence $$B = \frac{1}{\log_e b}.$$

Introducing this value of B in equation [4], we obtain

$$D(\log_b x) = \frac{Dx}{\log_e b.\, x}.$$

If $b = e$, we have $$D(\log_e x) = \frac{D\,x}{x}. \qquad [d]$$

e is known as the Napierian base. The computation of its approximate numerical value is deferred until after the introduction of Maclaurin's Theorem.

The *logarithmic differentials* of the Power, Product and Quotient may be deduced by means of the above result, in the usual way, since the demonstration is dependent on the four elementary propositions only.

THE DIFFERENTIAL OF THE EXPONENTIAL FUNCTION.

Let $$z = x + h, \text{ then } D\,z = D\,x; \qquad [1]$$

also $$a^z = a^{x+h} = a^h \cdot a^x \;[3] \text{ and } D(a^z) = a^h\, D(a^x). \qquad [2]$$

Dividing equation [2] by the product of [1] and [3], we obtain the desired form

$$\frac{1}{a^z} \cdot \frac{D(a^z)}{D\,z} = \frac{1}{a^x} \cdot \frac{D(a^x)}{D\,x} = c.$$

Whence $$D(a^x) = c\,a^x\,D\,x. \qquad [4]$$

To determine c, we differentiate the identity

$$x = \log_a a^x,$$

thus $$D\,x = \frac{D(a^x)}{\log_e a \cdot a^x} = \frac{c\,a^x\,D\,x}{\log_e a \cdot a^x};$$

∴ $$c = \log_e a.$$

Substituting this value of c in [4], we obtain

$$D\,(a^x) = \log_e a \cdot a^x \cdot D\,x. \qquad [e]$$

The Differentials of the Trigonometrical Functions.

Let $\quad z = x + h, \quad$ then $\quad D\,z = D\,x, \qquad$ [1]

also

$$\sin z = \sin x \cos h + \cos x \sin h,$$

$$= \cos h \cdot \sin x + \sin h \sqrt{1 - \sin^2 x}.$$

$$D\,(\sin z) = \cos h \cdot D\,(\sin x) + \sin h \,\frac{-\,2 \sin x \, D\,(\sin x)}{2\sqrt{1 - \sin^2 x}}$$

$$= \left[\cos h - \sin h \cdot \frac{\sin x}{\cos x}\right] D\,(\sin x). \qquad [2]$$

Combining [1] and [2]

$$\frac{D\,(\sin z)}{D\,z} = \frac{D\,(\sin x)}{D\,x} \cdot \frac{\cos h \cos x - \sin h \sin x}{\cos x}$$

$$= \frac{\cos z}{\cos x} \cdot \frac{D\,(\sin x)}{D\,x}, \qquad [3]$$

or, separating variables,

$$\frac{1}{\cos z} \cdot \frac{D\,(\sin z)}{D\,z} = \frac{1}{\cos x} \cdot \frac{D\,(\sin x)}{D\,x} = c\,;$$

$$\therefore \qquad D\,(\sin x) = c \cdot \cos x \cdot D\,x. \qquad [4]$$

To determine c (x being the circular measure of the angle)

Put $\quad \cos x = \sin\left(\frac{\pi}{2} - x\right).$

By [4] $\quad D\,(\cos x) = c \cdot \cos\left(\frac{\pi}{2} - x\right) D\left(\frac{\pi}{2} - x\right),$

or

$$D\,(\cos x) = -\,c \sin x \, D\,x. \qquad [5]$$

From [4] and [5] $\quad D\,(\tan x) = c \sec^2 x \, D\,x. \qquad$ [6]

Now in [4] c cannot be greater than unity, for if it were, $D\,(\sin x)$ would exceed $D\,x$ for all values of x less than a certain value. Hence, x and $\sin x$ starting together from zero, $\sin x$ would, for these values, exceed x, which is impossible.

Again, from [6] c cannot be less than unity, for then $D\,(\tan x)$

would be less than Dx for values of x below a certain fixed value, and x and $\tan x$, starting together from zero, $\tan x$ would be less than x for these values, which again is impossible;

$$\therefore \qquad C = 1.$$

Introducing this value of c in [4] [5] and [6] we obtain

$$D(\sin x) = \cos x \, Dx. \qquad [f]$$

$$D(\cos x) = -\sin x \, Dx. \qquad [g]$$

$$D(\tan x) = \sec^2 x \, Dx. \qquad [h]$$

The President communicated the following letter: —

CORDOBA, November 7, 1872.

TO THE PRESIDENT OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES.

DEAR SIR, — Upon my departure from home on the undertaking in which I am at present engaged, the Academy had the goodness to aid my plans materially by appropriating the sum of $ 500 in gold from the Rumford Fund for the purpose of supplying me with a star spectroscope and astronomical photometer, — with permission to transfer them at the same price to the Argentine government for permanent use in this hemisphere, in case that the means for their purchase by the National Observatory should become available.

The instruments were ordered without delay, and are now in my possession, in good order. But the numerous delays arising from the German war of 1870 postponed both the construction and the transportation of the apparatus; and the instruments did not reach Cordoba until all my energies had been so severely tasked in other directions as to preclude me from undertaking any spectroscopic or photometric observations for the present.

I had hoped to offer to the Academy some results obtained with these instruments, in recognition of the valuable aid so opportunely and generously afforded; and I do not yet relinquish the hope of so doing at some future time. Meanwhile I have the satisfaction of being able to announce that the funds have been provided for the acquisition of these instruments by the observatory, and have the honor of transmitting them herewith to the Academy, with my cordial thanks.

It may have some interest for the Academy to know that, in the two years which have elapsed since my arrival in Cordoba, the observatory buildings have been erected and equipped, where before that time was a desolate and waste expanse of broken ground, almost untrodden, except by prairie-dogs, foxes, and iguanas. A thorough survey of the entire southern heavens has been made, comprising a determination of the positions and brightness of all stars to a limit below the seventh magnitude inclusive, and the whole work then repeated for the twofold purpose of detecting errors and of recognizing any important changes in the stars themselves. This revision will in all probability have been completed before the close of 1872. Standards of magnitude have for the first time been established for each tenth of a unit, as far as the eighth magnitude, throughout the circumference of the heavens, and selected in that portion of the Northern Hemisphere which has an equal meridian altitude for this observatory and for the average of northern ones. A thorough revision of the constellations of this hemisphere has been accomplished, and definite boundaries established, which, if accepted by astronomers, as I have reason to believe will be the case, will put an end to the confusion that has hitherto existed. The zone observations for a Southern Catalogue have been organized and are now going on systematically through the whole region between the Tropic of Capricorn and the eightieth degree of South Declination, the positions of nearly seven thousand stars having been already determined. Three campaigns for longitude determinations by telegraph have been carried out with the view of improving the map of the continent; and when the pending determination of the longitude between this observatory and the National Observatory of Chile shall have been completed, the positions of many points in South America will be known with a precision quite comparable to that with which the principal points in the United States have been established.

Furthermore, a system of meteorological observations is now organizing, as a national establishment, intended to embrace all portions of this Republic from Bolivia to the Straits of Magellan, and from the Andes to the Pacific. Funds have been voted for furnishing the needful instruments to all who are able and willing to carry on the observations, and the whole organization, although under my charge for the present, is made independent of the observatory. Thus there is reason to hope that the strange and hitherto almost unknown meteorological peculiarities of this singular region will within a few years become well understood.

I yet indulge the hope that it may be within my power, in some future communication, to offer to the American Academy some results of permanent value obtained by means of the instruments which could not have been supplied but through its generous aid. Only the intense application required for the zone-observations delays at present those upon the physical character of the stars whose positions we are determining.

With great respect, I am, dear sir,
Your obedient servant,
B. A. GOULD.

The Treasurer stated that he had received $573, (the value in currency of $500 in gold,) returned by Dr. Gould to the Academy for reasons fully explained in his letter.

Professor J. M. Crafts described a series of tests recently made at the Institute of Technology, on the solubility of sulphide of arsenic in free chlorohydric acid, and on the fire-proof qualities of a concrete.

Professor Wolcott Gibbs announced that he had found that the higher alkaloids, strychnin, brucin, etc., form, with the phosphates and arsenates of uranium and of the metals of the magnesian group, well-defined salts corresponding to the well-known ammonio-magnesic phosphate and arsenate. Many of these salts yield splendid crystals, which promise to extend our power of separating the different alkaloids from each other. The uranic salts are remarkably insoluble, and will probably yield quantitative methods of analysis.

Dr. J. B. S. Jackson exhibited two photographs of the presumed fossil human skeleton lately exhumed at Mentone. He also exhibited a specimen of a urinary calculus, cut in two and polished to show its internal structure.

Six hundred and fifty-third Meeting.

January 29, 1873. — STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary stated that the list of Resident Fellows exceeded in number that allowed by the charter, and that, consequently, further elections could not be held at present.

The President announced the loss the Academy had sustained in the deaths of Professor Adam Sedgwick and Mr. W. J. M. Rankine, Foreign Honorary Members.

He also announced that he declined to be a candidate for re-election at the approaching Annual Meeting of the Academy.

Professor J. P. Cooke proposed an amendment of the statutes of the Academy relating to the election of Fellows. This proposition was referred to a committee consisting of Messrs. C. F. Adams, G. T. Bigelow, and J. P. Cooke.

Mr. Edmund Quincy proposed the insertion of a clause in the statutes relating to the removal of names from the list of members for non-payment of fees. His proposition was referred to the same committee.

Mr. S. P. Sharples read a paper on some methods of disposing of slaughter-house refuse.

Professor Joseph Lovering communicated the results of the computations made, under his direction, for the determination of the difference of longitude between Cambridge and Duxbury, Massachusetts, by means of telegraphic signals, and also for the determination of the difference of transatlantic longitude between Duxbury and Brest, France, by means of telegraphic signals exchanged through the French cable-line. He stated that three campaigns had already been conducted by the officers of the United States Coast Survey for the settlement of transatlantic longitudes. 1. The first was in the autumn of 1866, when the signals were sent through the English cable-line. 2. The second was in the winter of 1869–70. 3. The third was in the summer of 1872. In the second and third operations, the French cable-line was used. The communication of Professor Lovering related especially to the second of these campaigns, and was made by permission of Professor Benjamin Peirce, the Superintendent of the United States Coast Survey. A full account of the method of exchanging signals and the forms of computation will appear in Volume IX. of the Memoirs of the Academy. The final result, corrected for Personal Equation, is: —

Difference of longitude between Cambridge and Duxbury . .	$1^m\ 50^s.205 \pm .022$
Difference of longitude between Duxbury and Brest . .	$4^h\ 24^m\ 43^s.277 \pm .047$
Difference of longitude between Cambridge and Brest . .	$4^h\ 26^m\ 33^s.482 \pm .052$

Professor J. P. Cooke described a method he is employing for the manipulation of hydric sulphide.

The manipulation of hydric sulphide in a large laboratory has always been a difficult problem, and the inconveniences arising from the use of this reagent, in the state of gas, are so great, that, when a class of forty or fifty students are working with it at once, the nuisance becomes almost unbearable. When dissolved in water, however, this reagent gives as little trouble or annoyance as any other; but, as ordinarily prepared, the solution is so weak that the substance under examination is deluged with water before the required excess of the reagent has been added. This objection can be wholly overcome by dissolving the gas under pressure, and drawing off the solution from a siphon like soda-water, and, in any laboratory where water is supplied under pressure, such a supersaturated solution can be very readily prepared with a very simple apparatus, which may be mounted in the following manner.

We use for the purpose the common green glass bottles in which acids are usually sold by the druggists, only taking care to select strong bottles with a well-rounded neck about one and a quarter inches in diameter. Let us designate by A, B, and C three two-quart bottles of this description, and by D a similar but larger bottle, having a capacity of two gallons. In A, the gas is generated from ferrous sulphide, water, and sulphuric acid, in the ordinary way. We pass the gas from A, first through a wash bottle filled with moistened sponge, and through the distilled water with which the bottles B and C are about three fourths filled, the gas bubbling up as usual from glass tubes leading to the bottom of each bottle, and the excess, not absorbed by the water, passing forward to the large bottle C, which serves as a gasometer. All these bottles are fitted as tightly as possible with rubber stoppers, through which pass the stout glass tubes that conduct the gas. Through the stopper of D pass three such tubes: the first which brings the unabsorbed gas from C opens at the top of the bottle; the second is connected by a rubber hose with a water faucet, and reaches to the bottom of the bottle; the third serves simply as a vent. The bottles B and C are fitted each with two tubes, one to deliver the gas at the bottom of the bottle, and the second, opening from the top, to conduct away the excess. The gas generator A requires only an exit tube, and lastly the wash bottle is fitted in the ordinary way, save only that we pack it with well-washed sponge, by which the gas is more effectually purified than when it bubbles through a liquid. We use glass tubes of about $\frac{3}{16}$ inch bore, and rubber hose of the same calibre, but very stout, and made of pure vulcanized rubber. The rubber stoppers are cut from what we call *stopper cord*, which, as well as the hose, is made by the Boston Belting Company, corner Chauncy and Bedford Streets, Boston. In mounting the apparatus, we interpose two or three feet of hose between the several parts, so as to have sufficient freedom of motion to enable us to shake up the water with the gas in the bottles B and C. Over the ends of the tubes from each of the bottles B and C we stretch permanently two rubber connectors, cut from the hose just described, and depend wholly on *pressure taps*, acting on these connectors, for closing the bottles. While charging the water with gas the connectors are united to the hose by short lengths of glass tube, and subsequently the solution is drawn off through a bent glass tube slipped into one of the same connectors. The bottles, thus arranged, serve the same purpose as a soda-water siphon. The rubber stoppers soon become cemented to the glass, and are never removed, the bottles being filled, as they are vented, through the glass tubes. A rubber connector with a pressure tap must also be provided for the vent tube of the large bottle C, which serves, as we have said, to receive the unabsorbed gas. In charging the water, we leave the vent of this gasometer open until the air is expelled from the apparatus, and then connect the vent tube by a rubber hose with a manometer, which, if a common steam manometer is not at hand, can be easily extemporized with a glass tube and a little mercury. We now watch the pressure, and when it becomes equal to the water pressure on our faucet, we turn on the water head. On first opening the faucet, it is necessary to watch the process very closely, lest the water should be forced back into the generator, but the apparatus soon adjusts itself to the new conditions, and the absorption goes on as regularly as before. The unabsorbed gas is of course stored in the bottle C, and gradually pushes back the water, with which at first it is three fourths filled, into the supply pipe; but only a small portion of the gas is lost, and with the apparatus of the dimensions described, a two-gallon bottle is large enough to hold all the excess which escapes before the water is saturated. To insure perfect saturation, the water in each of the bottles B and C should be frequently shaken up with the gas, especially towards the end of the process.

We constantly use an apparatus mounted as above, with a water-head of about thirty feet. It would undoubtedly stand a much greater pressure, but a solution saturated under a pressure of two atmospheres is as strong as is desirable. For example, one hundred cubic centimetres of such a solution is more than sufficient to precipitate a gramme of antimony. For saturating four litres of water in an apparatus of the dimensions described above, the charge should be about 200 grammes of ferrous sulphide, about two litres of water, and 288 grammes, or 160 cubic centimetres, of sulphuric acid. As this amount of acid water, when at a low temperature, is insufficient to dissolve all the ferrous sulphate formed, we place the generator in front of a hot-air register. In dismounting the apparatus, we close first the inlet tube of the bottle B, and then remove the generator and wash bottle; but care must be taken to relieve the pressure on the generator very slowly. Otherwise the escaping gas will cause the acid solution of ferrous sulphate, left in the bottle, to boil over.

By the use of a solution of hydric sulphide in place of the gas, the consumption of ferrous sulphide in our large laboratory has been reduced twenty-fold; and when it is remembered that by the previous waste the air of the room was constantly poisoned, and the waste-pipes clogged with the undissolved sulphide of iron, carelessly washed into the sinks, the advantage will be appreciated. The gain in those processes of quantitative analysis where hydric sulphide is required is hardly less important. The bubbling of a gas through a liquid inevitably entails loss, which can be wholly avoided by using the solution; and, by regulating the pressure on the tap, the reagent can be delivered in the proportions required, and at the exact point where it is wanted. Complete precipitation, moreover, is effected in a few minutes; and, if the liquid is constantly stirred as the reagent slowly flows in, the precipitate will settle in a condition admirably adapted for filtering. Lastly, the separation of sulphur, which is often so excessive when the gas is employed, is diminished, if not prevented, by using the reagent in solution.

Six hundred and fifty-fourth Meeting.

February 11, 1873. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

Professor William Watson was appointed Recording Secretary *pro tem.*

The Corresponding Secretary read a communication from Professor E. P. Seaver, acknowledging his election into the Academy.

He also gave notice that seventy copies of the Life and Works of Count Rumford had been distributed to Foreign Honorary Members and other men of science in Europe.

The Committee to whom the amendment of the Statutes was referred made the following report.

It is recommended to the Academy to substitute for the first four lines of Section 2 in Chapter IX. of the Statutes the following, viz.: —

Candidates for election as Resident Fellows must be proposed by two or more Resident Fellows in a recommendation signed by them, specifying the section for which they are proposed; which recommendation shall be read at a meeting and thereupon referred to the Council for nomination. No person recommended shall be reported by the Council as a candidate for election unless he shall have received a written approval authorized and signed, at a meeting of the Council, by at least seven of its members, to be reported to the Academy at a stated meeting. No ballot shall be held on a nomination by the Council until the stated meeting next after such nomination has been reported to the Academy.

It was moved by Mr. Edmund Quincy that the report be accepted and placed on file, in order that the amendment might be acted upon after the proper interval.

The Academy elected Wilhelm Hofmeister, of Heidelberg, a Foreign Honorary Member in Class II., Section 2 (Botany), in place of the late Hugo von Mohl, of Tübingen.

On the motion of Mr. Quincy, the hall of the Academy was tendered to the Massachusetts Historical Society for Thursday next, and for such other times as may suit their convenience.

Professor J. M. Crafts read a paper on "The Volumetric Analysis of Iron Ore."

Professor E. N. Horsford read a communication on "The Columnar Structure of Ice."

Dr. Charles Pickering continued his remarks, made at a previous meeting, on the forming of the earth's crust as witnessed in a congealing lava-lake within the great crater on Hawaii: —

On the floor of this and of the terminal crater of Mauna Roa (both of which on crossing he found essentially alike), *sulphur* occurs in the form of invisible fumes, impeding respiration, and in little heaps of comminuted dry powder; while above, around the brink, the sulphur comes through steam-vents forming regular "fumaroles," and is all beautifully crystallized; water in the one instance being accessible, in the other not.

Might not the similar little heaps of dry, white, tasteless powder on the floor of these craters have become some familiar mineral, could they have obtained water of crystallization?

The only crystalline mineral he could discover in the Hawaiian lavas was *chrysolite*, pea-like, and, though nowhere abundant, universally diffused; in some instances attached to a thread of the capillary obsidian, and therefore already formed when it reached the atmosphere; more frequently embedded in solid lava, a foot, perhaps, from atmospheric contact. Chrysolite occurs also in the neighboring Mauna Kea conglomerate, but in little patches, and not in detached crystals; and especially deserves attention from its presence in meteorites recently announced, presenting unexpected analogy with the internal constituents of our own planet.

When the accumulation of liquid lava becomes so great that the walls of the crater give way, a portion is sometimes squeezed through cracks a thousand feet upward upon the very brink. From the great crater the escaping lava splits the rock before it on its way down to the sea, in some instances leaving behind a squeezed-up portion here and there upon its track.

In the eruption a few months before his visit, the lava, after thirty miles' progress in the above-described manner, coming out upon the surface, poured into the sea. The consequence was a sand-storm, unapproachable for some days. When this cleared up, the new lava was found to have encroached upon the sea, and on one side there was a sand beach half a mile long, — to the ordinary observer not differing from other sea beaches; but the mineralogist would note intermingled pea-like grains of chrysolite. These seemed more abundant than elsewhere, owing, perhaps, to greater coarseness under the winnowing; just such beaches are found encircling Tahiti, where there is no active volcano.

The great crater sometimes has silent eruptions; the lava, after accumulating to the required limit, drains off and disappears; and a vessel arriving will perhaps report having passed through quantities of dead fish floating. The escaping lava continues splitting its way under the sea, and the question arises, Does it eventually manufacture granite or other crystalline rock at the bottom of the sea? The elements are all present, as appears from Dr. C. T. Jackson's published analyses of the Hawaiian lavas, — the silica, alumina, sodium, — and in about the proper proportions.

In considering the intricate limited area of crystalline rock, abutting often on deep-sea fossils in sedimentary rock, and such fossils occurring on the crest and amid the snow of the Andes, we shall have to conclude that every foot of what is now land was once the bottom of the ocean. On the other hand, a portion of what is now the bottom of the ocean was once land, as appears from coal-beds in Rhode Island and elsewhere extending underneath the sea-margin.

Professor H. P. Bowditch made a communication on "The Lymph Spaces in Fasciæ, with a new Method of Injection."

The lymph spaces existing between the tendinous fibres of fasciæ, and the connection of these spaces with lymphatic vessels, have been well described and figured by Ludwig and Schweigger-Seidel in their monograph on this subject.*

The researches of Dr. Genersich † have shown that the fasciæ, in virtue of this structure, play a very important part in keeping up the flow of lymph through the lymphatic vessels. His first experiment was as follows: A piece of fascia was removed from the leg of a dog, and tied over the mouth of a small glass funnel with the inner side (i. e. the side next to the muscles) uppermost. A few drops of a turpentine solution, the extract of alcanna root, were then placed upon this surface, and the fascia alternately stretched and relaxed by partially exhausting the air from the funnel and letting it return again. In this way the coloring matter was made to penetrate into the spaces between the fibres of the fascia, and to enter the lymph vessels on the opposite side. The same result was obtained when the coloring matter was injected between the muscle and the fascia, and the latter stretched and relaxed by passive movements of the limb. Experiments on animals where the flow of lymph through the thoracic duct was measured, showed that passive movements of the limbs increased this flow in a very striking manner. Galvanization of the muscles had a similar but less powerful effect.

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* Die Lymphgefässe der Fascien und Schuen. Leipzig. 1872.

† Arbeiten aus der physiologischen Aushalt zu Leipzig. V Jahrgang, p. 53.

The alternate widening and narrowing of the lymph spaces between the tendinous fibres seems therefore to cause the absorption of the lymph from the neighboring parts as well as its onward flow into the lymph vessels, the valves in these latter preventing, of course, a flow in the opposite direction.

In this function of the fasciæ we may perhaps find an explanation of the success of the Swedish movement-cure and of all methods of treatment which involve passive movements of the limbs, the removal of effete matters from the tissues being favored by an increased flow of lymph.

The turpentine solution of alcannine has several advantages for the injection of lymph spaces. Since turpentine does not mix with water, there is no possibility of the coloring matter being diffused by imbibition through the tissues, and thus obscuring the anatomical relations of the parts. The same immiscibility prevents also all swelling or shrinking of the tissues as a consequence of the injection. This is always to be feared when watery or alcoholic fluids are used.

A very good method of injecting the lymph spaces is as follows: Let a piece of fascia, carefully freed from loose connective tissue, be stretched somewhat tightly over the neck of a bottle. The point of a hypodermic syringe filled with the turpentine solution must be then passed obliquely into the fascia, care being taken that the point does not penetrate entirely through. If the fluid is then forced from the syringe, it will pass for a short distance into the lymph spaces, but a large portion of it will form a sort of an extravasation in the neighborhood of the point of injection. Several such partial injections may be made near the border of the piece of fascia, which must then be allowed to dry, still stretched upon the neck of the bottle. In drying, the tendinous fibres seem to shrink together, causing a dilatation of the spaces between them, in consequence of which the extravasated fluid is sucked onwards into the finest lymph spaces. In this way two, three, or even four layers of lymph spaces lying between as many different layers of tendinous fibres may be clearly demonstrated. The dried fascia may be mounted in Canada balsam between glass plates. The accompanying drawing by Dr. Quincy represents the appearance of the fascia under a low magnifying power.

Mr. E. N. Horsford read the following paper upon the Cause of the Columnar Structure of Decaying Ice: —

It is a familiar fact that ice on lakes and rivers frequently assumes, in melting, a peculiar honeycomb structure. It has been more especially remarked in the spring, by persons whose residences or pursuits have brought them in contact with the phenomena of the sudden disappearance of ice that but a short time before was thick and apparently sound.* When blocks of solid ice have been thrown on the shore of a lake or river, they more strikingly exhibit, after a few days of sunshine and a temperature above that of freezing, a structure in which the whole mass of ice seems resolved into closely set groups of irregular prisms, in the main perpendicular to the original horizontal surface.

This mass frequently retains for a long time its nearly full dimensions, while steadily lessening in weight, from the solution of the walls of what may be called the inter-columnar spaces, until at last the cohesion between the columns is overcome by gravity or slight agitation, and what remains falls to pieces, a pile of long, slender, angular rods. The diameter of these rods or irregular prisms is sometimes more than an inch, and it is sometimes less than that of a knitting-needle.

The same change frequently takes place in ice afloat, and when far advanced the ice columns may be thrust down by the foot, leaving a sharp, vertical wall around the space through which the foot has passed.

It has also been observed that where straw or litter has been dis-

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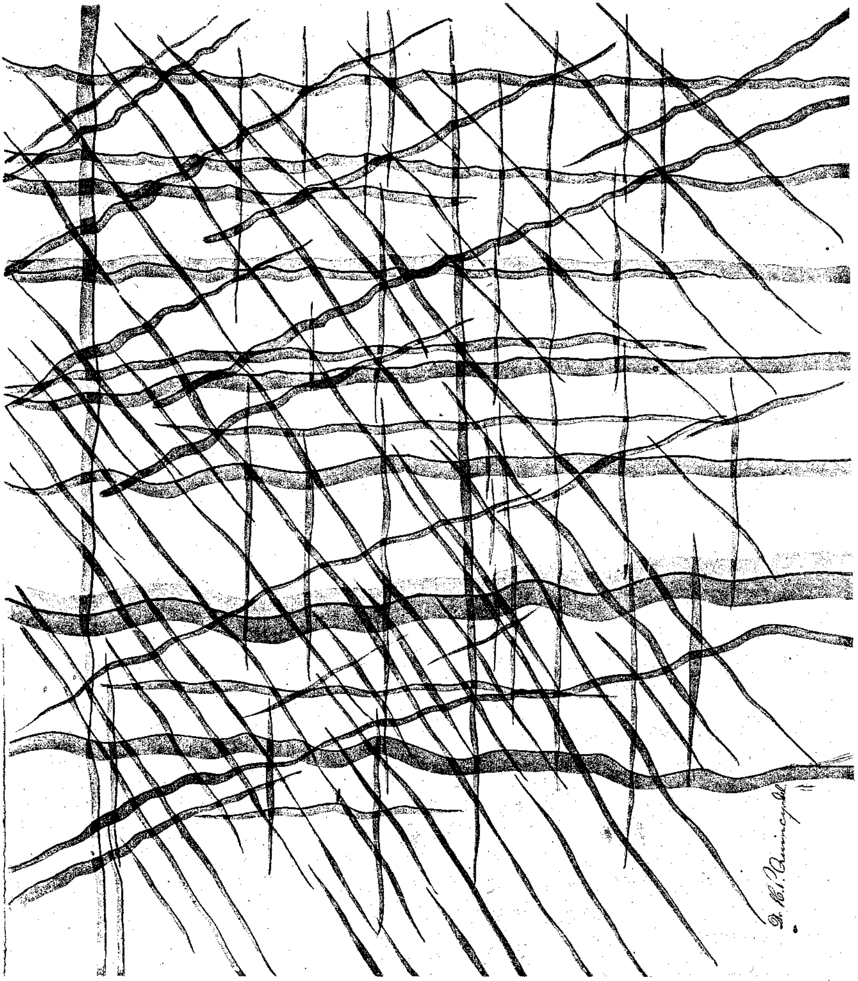
* Rev. Zadock Thompson, "Silliman's Journal," Vol. XII. 2d Series, 1851, p. 23. General Totten, chief of the engineers of the United States Army, Amer. Assoc. Adv. Science, Report for 1851. "Silliman's Journal," 2d Series, Vol. XXVIII. p. 359.


D. M. I. Quincy del.

tributed upon the ice, as in the case of a roadway across a stream or pond, the transit may be safe along the beaten track long after horses and vehicles would sink on either side. The ice in the latter case had been sheltered from the sun.

Areas of ice swept of a light fall of snow will become soft at times when neighboring ice, protected by the snow, will retain its glare and hardness. The significance of the fact of exposure to the sun's rays will presently appear.

Some sixteen years ago I began the study of this problem by taking a series of photographs of the vertical surfaces of blocks of ice, transparent and apparently thoroughly solid, or nearly so, throughout, as they slowly melted under the direct rays of the sun. These photographs, successively taken at intervals of about half an hour, showed a constant approach to columnar structure.

I exposed water to be frozen in vessels of various shapes, and photographed the ice obtained, and found the columnar structure in general perpendicular to the outer surface of the ice. When the surface was convex below, the columns curved upward toward the centre of the mass.

While pursuing this mode of investigation, I conceived the idea of taking plaster casts of the decaying ice. By placing the blocks of honeycombed ice in boxes and pouring liquid plaster, such as is used by stucco-workers, over the ice, the plaster flowed in to take the place the melted ice had left, and "*set.*" In a few hours the enclosed ice melted, and the water flowed out or escaped by evaporation. On permitting the cast carefully to dry, which was facilitated by removing the upper crust of plaster and exposing the interior to the air, and then touching the slender rods of plaster with a camel's-hair pencil dipped in a weak solution of gum-arabic, and repeating this process for several times with alternate drying, the whole cast at length acquired such consistency as to admit of being moved about with safety. The forms which were thus obtained from ice in various stages of decay, from large open ponds and from pools, were of great beauty and full of material for study.

I desire chiefly in this note to present what I conceive to be the solution of the problem of this columnar structure, that others who may perhaps have better opportunities than myself may apply the explanation and test it.

When water, by cooling at the surface, has throughout obtained its greatest density, the circulation from above downward, and the reverse, ceases. This takes place at a temperature of some 39.2 degrees Fahr. Thenceforward further reduction of temperature causes the water to congeal and expand at the surface. As still further reduction of temperature at the surface goes on, the thickness of the ice increases from below, and with this cooling comes a contraction of the superior portions of the ice. This contraction, like that of lava shrinking from loss of heat, or like that of large blocks of moist starch shrinking from loss of water, is accompanied by separation of the mass into slender columns by thin blades of space. In the case of ice, thin blades extend from above downward, and divide the ice into a kind of cellular structure. This structure in the ice, though actual, may be inappreciable to the eye, except in cases where the cells are sufficiently pronounced to become visible through the filaments or blades of air which fill the spaces left by the shrinking ice. The cracks, by which I mean the visible openings in the ice, which are readily commensurable, being frequently a considerable fraction of an inch across, I have observed in many, perhaps in most instances, are not readily traced to the bottom of the ice, but are wedge-shaped and broadest at the top. This is not invariable, however. Under some conditions I have seen the opposite sides of the cracks displaced, and the whole neighboring surface, stretching away from the crack, slightly curved downward, while the walls of the crack are lifted. This conformation would naturally follow the reduction of temperature and shrinking from above. At the bottom the ice must of course remain at 32°. In areas of ice which have been thus subjected to contraction producing visible cracks, the openings fill with water from below, which freezes, and marks by its somewhat contrasted clearness the site of the cracks. I have noticed in these cracks a peculiar transverse columnar structure, the explanation of which does not seem difficult, as will presently appear.

When, to a period of low temperature, and the production of cracks and their filling with water and freezing, there succeeds a period of warm weather, the whole body of the ice expands. Now, under the pressure consequent on this expansion, if the temperature rises to 32°, the space of the cracks filled with water must be provided for; and as the only relief for this is by increasing the thickness of the ice, or, in other words, in an elongation of the rods of ice in the honeycomb frame, there must be produced a slight vertical molecular movement which still further individualizes the columns. Thus contraction and expansion are in the course of the winter repeated with every cycle of temperature going above and below freezing, until when exposed to the higher sun of spring, or even the direct sun during the winter, especially in the case of a detached block, the surfaces of the honeycomb structure are separated from each other by the solution of the contiguous walls of ice.

The production of transverse horizontal columnar structure in the ice of the cracks above referred to is a direct result of the freezing of the water in the crack, first at the surface of contact with ice of a temperature below the freezing point.

A like columnar structure I have observed when water in bottles was frozen, as already alluded to, by exposure out of doors on very cold nights. The ice from the surface in contact with the glass is, in such cases, frequently filamentous, as if slender visible tubes converged in a general way toward the vertical axis of the bottle. Strictly speaking, the direction of the filaments is uniformly approaching a perpendicular to the surface of the bottle, whatever its conformation.

These slender white threads I have proved to be primarily, not air-tubes, but empty spaces, though when the ends of the tubes are exposed by fracture, they, of course, instantly fill with air.

As a proof that these are empty spaces, I may mention that I exposed a quantity of water in a cylindrical cast-iron vessel with rounded bottom of some half-gallon capacity to a freezing temperature in which the whole water became solid. On examining the transparent block, I noticed near the centre of the upper surface what seemed a large air-bubble shut in below a layer of ice about an eighth of an inch in thickness at the thinnest part. Around the margin of this air-bubble I raised a little wall of wax, and filled the space within the wall with colored water. With a needle I then drilled through the film of ice to the space below, when, on withdrawing the needle, the fluid passed with a rush to the before vacant cavity, filling it completely without escape of bubbles.

This vacuum had been produced by the shrinking of the main body of the ice, due to the cold after the formation of the exterior crust encasing the largest volume of the ice, the shrinking of the ice taking place while there was still a portion of water not solidified. The space left by the shrinking, filling with the remaining water, left a vacuum.

Like cavities I have produced in bottles filled with water and exposed to low temperature. The phenomenon is the same as that observed in the cooling of large cylindrical iron castings. From such cavities I have plucked out detached octahedral skeleton crystals of iron.

The phenomena of ice structure vary so greatly with the circumstances under which congelation takes place, that they seem almost infinite. Large areas of ice seem to me under certain conditions to be produced in considerable degree from what might be regarded as a snow-storm from below — the whole body of ice seeming to be made up of snow-flakes — of marvellous beauty. I have seen a snow-flake in the interior of a block of ice not less than two inches in horizontal diameter, and perfect in all its parts.

Tyndall figures a block full of these snow-flakes revealed by directing a concentrated sunbeam successively on different points in the interior of a block. In others I have found numerous fern-leaf crystals (segments of the great snow-flake) in vertical position, and several of my casts of decaying ice show the pseudomorphs of fern leaves which have dissolved out therefrom.

I have found in little cavities, commonly known as air-holes, the under surface of the thin film of ice roofing over the air space and its floor below, minute six-sided tabular crystals of dimensions great enough to be readily recognized with the unaided eye.

It is not the purpose of this note to embrace a detailed account of the observations I have made upon the phenomena of ice, but is mainly, as I have said, to present the conception I entertain of the cause of the columnar structure of decaying ice.

I conceive it to be due primarily to the alternate expansion and contraction of the ice, consequent upon cycles of temperature, resulting first in minute fissures from the shrinking, induced by cold, which, filling with air, yield a sort of honeycomb structure; and, secondarily, to the cellular structure produced by the intersection of vertical or nearly vertical blades of ice crystals, which protruded from the continuous ice above into the water below, as the thickness of the ice increased, and which vertical blades determined the surfaces where the sun's rays at the time of reflection are resolved into dark heat; and, thirdly, the elongation of the columns enclosed by the honeycomb structure consequent on the pressure caused by expansion.

The second phenomenon is like that afforded by subjecting blocks of wax to pressure. The aggregations of imperfect crystals in the case of wax are flattened out, the surface planes or planes of separation of the crystals being preserved and extended under the pressure. In ice this preservation of surface may be aided by the thin film of air which occupies the minute fissures occasioned by the shrinking of the ice. This may perhaps influence regelation, and serve to keep the columns thus honeycombed from amalgamating.

The rays of the sun falling upon and penetrating this ice are at each interior surface more or less arrested and converted into dark heat, like the heat received from the sun by the earth, and returned to the air in contact with and near the surface, and convert the ice along the planes of separation to water.

The repetition of this process at length so far separates the columns from each other that a slight strain disengages them, and the columns fall asunder, if in water to rapidly disappear in solution.*

Six hundred and fifty-fifth Meeting.

March 11, 1873. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

The President announced the death of Hon. James Savage, a Resident Fellow; also that of Professor John Torrey, of New York, an Associate Fellow.

The verbal changes in Chapter IX., Section 3, of the Statutes, having for their object to make it conform as nearly as possible to Section 2, as amended, were referred to the President and Recording Secretary.

A paper on the "General Equation," by G. W. Pierce, was referred to the Recording Secretary.

Professor H. P. Bowditch moved that a committee of five be appointed to consider the propriety of seeking to obtain legislation providing better methods of procuring expert testimony in the courts of this Commonwealth; and that the committee so appointed be instructed to confer with the committees appointed for the same purpose by the Suffolk District Medical Society, and by the Boston Society of Medical Sciences.

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* General Totten, in the paper above referred to, suggests that the columnar structure is determined in the original formation of the ice by vertical prisms shot down from above, which increase by lateral accretion till they drive all the air in solution in the water into thin vertical films, marking the boundaries of the crystals. This suggestion may be entitled to higher consideration than my observations lead me to attach to it. It does not seem at all to meet the case of ice made up of snow-flakes. The cavities or threads or filaments in ice are, moreover, as I have demonstrated, *vacua*, and not spaces filled with air.

Extended remarks on this motion were made by H. P. Bowditch, Edward Jarvis, C. T. Jackson, Henry W. Williams, and Emory Washburn.

The motion was adopted, and the President appointed on this committee Emory Washburn, Horace Gray, Edward H. Clarke, H. L. Eustis, and Wolcott Gibbs.

Professor John Trowbridge made a communication on "Induced Thermo-electric Currents," being a continuation of a paper on "Animal Electricity" presented at a previous meeting.

Mr. W. A. Rogers described a method for dispensing with tangent-screws and verniers in instruments.

Professor Joseph Winlock exhibited a method of representing the nebulæ, being a reproduction of the original drawings by the *heliotype* process. He also made a communication on the sun-spot observations taken at the Kew Observatory during the year 1872 by Warren de la Rue, with the corresponding observations at Cambridge, Massachusetts.

Six hundred and fifty-sixth Meeting.

April 8, 1873. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President announced the death of Joseph Hale Abbot, a Resident Fellow.

Professor J. D. Whitney presented to the Academy four volumes of his "Report on the Geological Survey of California."

A portion of the report of the Council was read by the President, namely, the eulogy of the late Professor John Torrey.

Professor J. D. Whitney then made a communication on the reliability of the barometer as a hypsometrical instrument, being the results of the comparison of a series of elevations determined by barometric observations with those obtained by the accurate method of the spirit-level. These observations were made on the line of the Central Pacific Railroad.

The Corresponding Secretary read a second portion of the report of the Council, namely, the eulogy of General George G. Meade.

Six hundred and fifty-seventh meeting.

May 13, 1873. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President read a letter from the Massachusetts Historical Society, thanking the members of the Academy for the use of their Hall on several occasions; also a letter from Wilhelm Hofmeister, of Heidelberg, acknowledging his election into the Academy.

The President announced the death of an Associate Fellow, namely, W. S. Sullivant, of Columbus, Ohio. He also gave notice of the deaths of two Foreign Honorary Members, namely, Justus von Liebig, of Munich, and John Stuart Mill, of London.

A portion of the report of the Council was then read, namely, the eulogies of the late Francis Lieber and James Hadley.

Professor Joseph Winlock made a communication on a comet of 1867, which had a period of six years. It was identified on April 4, 1873, near its predicted place.

He also described a new method of illuminating the spider-lines of the telescopes in Harvard College Observatory, and a modification of the chronograph.

The President communicated the following botanical papers: —

Revision of the extra-tropical North American Species of the Genus Lupinus. By SERENO WATSON.

The latest revision of the Lupines is that in Torrey and Gray's Flora, made thirty-five years ago, and including all the species founded upon the collections of Douglas, Wyeth, and Nuttall. The amount of material that has since been gathered justifies an attempt at a rearrangement of the genus. In this revisal the herbariums of Dr. Gray, Dr. Torrey, Professor Eaton, and of the Philadelphia Academy have been consulted, and much aid in identifying many of the older species has been derived from notes made by Dr. Gray upon typical specimens in the British herbariums (especially that of Lindley, which was the basis of Agardh's Synopsis), which he examined and compared with his own specimens during his last visit to Europe.

In view of the peculiar difficulties that lie here in the way of determining specific differences and defining them, I can hope to have attained scarcely more than moderate success in giving clear and satisfactory descriptions. It will be seen, however, that there are three well-marked sections, the largest of which is conveniently divided into perennials and annuals. In the minor subdivisions, use is made mainly of differences in habit and in the number of ovules, which are found to be in most cases very constant. Little use is made of the characters of the seed, the differences in the calyx are mostly slight and not easily expressed, the color of the petals is often variable and changeable and in dried specimens uncertain, and peculiarities of pubescence or foliage, which in some cases seem very constant and reliable, in others are not to be depended upon. Several species still remain to some extent uncertain for want of sufficient material for comparison. Some new species have been indicated, though as many others have been reduced, and future explorations in the Lupine Region, from the Rocky Mountains to the Pacific, will doubtless add to the list.

Synopsis of Species.

§ 1. LUPINUS, proper. Flowers in terminal racemes; banner with strongly reflexed sides; ovules several; cotyledons petioled after germination; pods broadly linear. — Spec. 1 – 50.

* Unifoliolate perennials.

Pubescence villous, spreading; stipules elongated; leaves lance-oblong, acute; ovules 4 – 6 . . . . 1. *L. villosus.*

Pubescence mostly appressed and short; stipules short; leaves oval or obovate, obtuse, short-petioled; ovules 6 – 10 . . . . 2. *L. diffusus.*

* * Perennial; leaflets 5 – 15. — Spec. 3 – 39.

† Shrubby at base, tall and leafy; pubescence silky, mostly appressed; leaflets 7 – 11; petioles short; bracts deciduous; flowers large; ovules many.

Pubescence not dense; leaflets glabrate above, narrowly lanceolate, acute; fls. yellow; calyx-lips subentire; ovules 10 – 12 . . . . 3. *L. arboreus.*

Pubescence dense; lfts. wedge-obovate, obtuse, silky both sides; fls. not yellow; upper lip bifid; ovules 6–8 . . . . 4. *L. albifrons.*

Pubescence short and mostly tomentose; lfts. oblanceolate, not smoother above; bracts exceeding the calyx; fls. blue; upper lip nearly 2-parted; ovules 8–9 . . . . 5. *L. Douglasii.*

† † Stems wholly herbaceous, more or less elongated, in (*a*) mostly succulent and fistulous.

a. Lfts. smooth above, oblanceolate, $1\frac{1}{2}'$ long or more, except in *L. littoralis;* bracts deciduous; calyx-lips slightly toothed; ovules 8 or more.

Subdecumbent, densely villous; stipules long-setaceous; petioles short; lfts. 6–8; bracts short; ovules 9–12 . . . . 6. *L. Nootkatensis.*

Erect, sparingly villous; stipules broad; petioles elongated; lfts. 10–16; bracts short; calyx-lips entire; ovules 9 . . . . 7. *L. polyphyllus.*

Ascending, villous; leaves distant; petioles elongated; lfts. 8–12; bracts exceeding the calyx; ovules 7–8 . . . . 8. *L. Wyethii.*

Erect, nearly glabrous, the short pubescence mostly appressed; stipules narrow; petioles short; bracts exceeding the calyx; ovules 8–10 . . . 9. *L. rivularis.*

Calyx subvillous; bracts more hairy, subpersistent; stipules broader; lower petioles elongated; pedicels short . . . . 10. *L. Burkei.*

Subdecumbent, slender, leafy; petioles short; lfts. 5–8, $\frac{1}{2}$–1′ long; bracts exceeding the calyx; keel ciliate; ovules 10–12 . . . . . 11. *L. littoralis.*

b. Leaves distant, lower long-petioled; lfts. smooth above; fls. large, not yellow; ovules 6–7, rarely fewer.

Pubescence mostly minute, appressed; stipules deciduous; lfts. 9; upper calyx-lip shortly toothed; keel ciliate . . . . 12. *L. perennis.*

Usually villous, low and slender; stipules long, persistent; upper lip bifid; ovules 4–6 . . 13. *L. Nuttallii.*

Villous or subglabrous; stipules large, acuminate; lfts. 7; keel naked . . . . 14. *L. arcticus.*

c. Leafy and branching; petioles short; bracts deciduous, shorter than the calyx, except in *L. Sabinii* and *barbiger;* fls. large, yellow in *L. Sabinii;* ovules 6–7, rarely 8.

Lfts. silky both sides; fls. very large, yellow; banner naked . . . . 15. *L. Sabinii.*

Lfts. pubescent both sides; calyx-lips subequal, the upper narrow; banner acute, margins adherent at the apex; keel very falcate, naked . . . 16. *L. albicaulis.*

Lfts. smooth above; upper lip shorter, broader; banner acutish; keel ciliate, less falcate . . . 17. *L. Sitgreavii.*

Lfts. subappressed-silky both sides; pubescence of stem and pedicels dense and spreading; bracts long; banner silky; keel strongly bearded . 18. *L. barbiger.*

Lfts. 5 – 7; pubescence appressed, silky, usually short; banner silky; keel ciliate . . . . 19. *L. ornatus.*

d. Leaves distant, not smooth above; lower petioles elongated; racemes mostly dense and fls. smaller, except in *L. sulphureus;* ovules 4 – 6.

Flowers yellow . . . . 20. *L. sulphureus.*

Pubescence villous, spreading; bracts deciduous, often exceeding the densely villous calyx; calyx-lips subequal; banner hairy; keel ciliate . . 21. *L. sericeus.*

Stout, densely silky-tomentose; pedicels very short; bracts subpersistent; banner very villous 22. *L. leucophyllus.*

Densely rough-pubescent with spreading hairs; pedicels short; bracts short, deciduous; banner subhairy . . . . 23. *L. Palmeri.*

Densely appressed-silky, leafy at base, often low; petioles elongated; bracts deciduous; banner naked . . . . 24. *L. lepidus.*

Silky-villous; raceme dense; bracts persistent, equalling the calyx; fls. verticillate; banner oblong, naked . . . . 25. *L. confertus.*

e. Leafy; petioles short; racemes short-peduncled; bracts deciduous, mostly short; fls. mostly small, not yellow; ovules 3 – 5.

Subdecumbent; pubescence mostly short; lfts. silky both sides; bracts at least equalling the calyx; banner very hairy; keel very ciliate . 26. *L. flexuosus.*

Erect, slender, much branched, puberulent; lfts. pubescent both sides; banner and keel naked . 27. *L. Andersoni.*

Erect, slender, strict, scantily puberulent; lfts. glabrous above; bracts equalling the silky calyx; banner naked . . . . 28. *L. parviflorus.*

Appressed-subsilky; lfts. oblanceolate, pubescent both sides; calyx strongly spurred; banner longest, hairy; keel ciliate . . . . . . 29. *L. calcaratus.*

Appressed puberulent; lfts. narrowly oblanceolate, pubescent both sides; calyx narrow, saccate; petals equal; banner subpubescent; keel ciliate 30. *L. laxiflorus.*

Appressed puberulent or silky; lfts. linear-lanceolate, smooth above; calyx campanulate, gibbous; petals equal; banner subhairy . . 31. *L. argenteus.*

Close silvery-silky; lfts. oblanceolate, very silky both sides; fls. often very small; calyx slightly spurred; banner pubescent; keel ciliate . . 32. *L. holosericeus.*

Densely silky-tomentose; lfts. silky both sides; bracts ovate; fls. very small; calyx campanulate; banner naked; ovules 3 – 4 . . . . . 33. *L. meionanthus.*

† † † Dwarf, short-stemmed and mostly cæspitose; bracts subpersistent; fls. subverticillate, short-pedicelled; keel ciliate; ovules 3 – 6.

Stems very short; racemes sessile; bracts exceeding the calyx; banner narrow . . . . . . 34. *L. cæspitosus.*

Stems with rather long internodes, herbaceous; racemes peduncled.

Loosely villous; bracts nearly equalling or exceeding the short calyx; lower lip subentire; ovules 4 – 6 . . . . 35. *L. aridus.*

Loosely villous; bracts short; calyx nearly equalling the petals; lower lip equally 3-toothed; banner short, narrow, rhomboidal; ovules 2 – 3; pod ovate . . . . 36. *L. Kingii.*

Appressed villous; bracts short, deciduous; calyx short, upper lip bifid; petals equal; banner orbicular . . . . 37. *L. minimus.*

Stems leafy, from a spreading woody caudex; racemes very short; bracts short; pubescence dense, appressed.

Lfts. 7 – 10, obtuse; petioles short; peduncles equalling the leaves; banner orbicular . . 38. *L. Breweri.*

Lfts. 5 – 6, acutish; petioles elongated; peduncles exceeding the leaves; banner elliptical . 39. *L. Lyallii.*

* * * Annuals; leaflets 5 – 10; upper calyx-lip 2-parted or bifid. — Spec. 40 – 50.

† Fls. verticillate; bracts deciduous.

Puberulent; lfts. cuneate-obovate, mostly obtuse, smoother above; bracts short . . . . 40. *L. affinis.*

Usually villous; lfts. linear to oblanceolate, acute, pubescent both sides; bracts elongated; fls. 3 – 6″ long; banner broad . . . . 41. *L. nanus.*

Villous; lfts. linear, pubescent; bracts short; pedicels very short; fls. 2 – 3″ long, narrow . . 42. *L. micranthus.*

† † Fls. scattered; bracts persistent in Nos. 46, 49, and 50.

a. Rather tall, slender; lfts. linear.

Lfts. 8 – 10, smooth above; bracts very long . 43. *L. leptophyllus.*

Villous; lfts. 5 – 9, much reduced upward; bracts short, subpersistent . . . . 44. *L. sparsiflorus.*

Puberulent; lfts. 5–7, truncate; bracts short . 45. *L. truncatus.*

b. Lfts. 5–7, cuneate-obovate, sometimes oblanceolate in 49; bracts and petioles short.

Silky-pubescent; lfts. 5; Texan . . . . 46. *L. subcarnosus.*

Puberulent; raceme short, dense; banner yellow, wings pink; pod smooth . . . . . 47. *L. Stiveri.*

Very hirsute, rather stout; petals 6″ long . 48. *L. hirsutissimus.*

Low, villous; petals 3–4″ long; lower calyx-lip narrow, rather deeply trifid . . . . 49. *L. concinnus.*

Low, slender, very hairy; raceme few-flowered, flexuous; lower lip broad, subentire; fls. narrow, 2–3″ long . . . . 50. *L. gracilis.*

§ 2. PLATYCARPOS. Fls. as in § *Lupinus;* ovules 2; cotyledons broad and clasping; pods ovate; bracts persistent; lfts. cuneate-oblong or -obovate after germination; annuals.

* Fls. verticillate; stems tall; racemes long-peduncled.

† Leaves approximate, long-petioled.

Villous with long hairs; fls. mostly purple . . 51. *L. microcarpus.*

Less villous with shorter hairs; calyx nearly smooth; fls. yellow to white . . . . . 52. *L. densiflorus.*

† † Leaves scattered; petioles short.

Pubescence short, appressed . . . . . 53. *L. Bridgesii.*

* * Fls. scattered; low or dwarf.

Very hirsute; lfts. usually 5; racemes nearly sessile; upper calyx-lip 2-cleft . . . . 54. *L. pusillus.*

Nearly acaulescent; less hairy; lfts. usually 7; peduncles about equalling the leaves; upper lip very short, truncate . . . . 55. *L. brevicaulis.*

§ 3. LUPINELLUS. Fls. axillary, solitary; sides of the banner scarcely reflexed; pod ovate; ovules 2.

Annual, dwarf, diffuse, villous; lfts. 5; fls. small . . . 56. *L. uncialis.*

§ 1. LUPINUS, proper. Flowers in terminal racemes; banner with its sides strongly reflexed; ovules several (5–12); cotyledons petioled, after germination.

* Herbaceous perennials; leaflets solitary; pubescence densely silky; bracts deciduous; flowers subverticillate.

1. L. villosus, Willd. Stem stout, decumbent at base or ascending, 1–2° high, leafy; pubescence densely silky-tomentose and villous, especially on the stem and stipules; stipules 1–2′ long, setaceous; leaves lance-oblong, 2–6′ long, about equalling the petioles, acute; racemes 6–10′ long, often dense, short-peduncled; bracts about equalling or exceeding the calyx, subulate-setaceous; pedicels 1–2″

long; calyx nearly equalling the petals, the lips subequal and toothed, bractlets setaceous; petals pale-red, the rounded banner with a dark-purple centre; keel naked; ovules 4 – 6; pods densely villous, in a crowded cylindrical spike, 1′ long, 2 – 4-seeded. — Dry sandy barrens; Georgia to Florida and Alabama; April.

2. L. DIFFUSUS, Nutt. Resembling the last; procumbent; pubescence shorter, appressed, rarely subspreading; leaves short-oblong, 1 – 3′ long, obtuse and mucronulate, sometimes acutish, mostly exceeding the petioles; stipules 3 – 9″ long; bracts lanceolate or oblong, shorter than the calyx; calyx considerably shorter than the petals, and with shorter bractlets; flowers mostly smaller, 4 – 6″ long, light-blue, the banner with a greenish-yellow centre, less decidedly rounded, or acutish; ovules 6 – 10; pod densely covered with shorter stiffish hairs. — North Carolina to Florida.

* * Perennials; leaflets 5 – 15. — Spec. 3 – 39.

† Shrubby, at least at base, tall, branched, and leafy; pubescence silky, mostly appressed; leaflets 7 – 11; petioles rarely much exceeding the leaves; bracts deciduous; flowers large; calyx-lips nearly equal; ovules mostly 8 – 12.

3. L. ARBOREUS, Sims. Shrubby and often 4 – 10° high; pubescence not dense, short and silky, mostly appressed; leaflets 7 – 11, mostly 9, glabrate above, narrowly lanceolate, ¾ – 1¾′ long, acute; raceme loose, 3 – 8′ long; bracts linear, equalling the calyx; flowers verticillate or subscattered, sulphur-yellow, fragrant; pedicels 3 – 4″ long; calyx-lips broad, entire or the upper obscurely 2-toothed; bractlets minute; petals 6 – 8″ long, equal, keel slightly ciliate; pod 10 – 12- (rarely 8-) seeded, 1½ – 3′ long, 4 – 6″ wide, pubescent. — California, common, from Sacramento Valley to San Diego; April to August. Specimens from Punta de los Reyes (Bigelow) are remarkable for their more abundant villous pubescence, spreading upon the stem.

4. L. ALBIFRONS, Benth. Stems 1 – 4° high; pubescence dense, silky, appressed; leaflets 7 – 9, cuneate-obovate, ½ – 1′ long, obtuse and mucronulate, or acutish, silky on both sides; racemes loose; bracts lanceolate, shorter than the calyx; flowers subverticillate, blue, violet, pink, or white; pedicels 2 – 3″ long; calyx with small setaceous bractlets, upper lip deeply cleft, the lower subentire; petals 6″ long, equal or the banner slightly shorter, keel naked or ciliate; ovules 6 – 8; pod 1¼′ long, 4 – 6-seeded, silky. — From Oregon (Hall) to Southern Cali-

fornia, common. No. 615 Thurber, from San Pasqual, has stout, elongated, few-leaved stems, the raceme over 1° long, and the leaflets 2½′ long, but it evidently belongs here.

5. L. Douglasii, Agh. Apparently less woody; pubescence short, tomentose or silky, appressed; leaflets 7 – 9, oblanceolate, 1 – 1½′ long; obtuse or acute, sometimes cuneate-oblong, pubescent on both sides; racemes often long-peduncled; bracts linear-setaceous, exceeding the calyx; flowers blue or purple, scattered or subverticillate; pedicels 3 – 5″ long; calyx with long setaceous bractlets, the upper lip nearly 2-parted, the lower entire; petals equal, 6 – 7″ long, keel ciliate; ovules 8 – 9. — Sacramento Valley to Southern California.

† † Stems wholly herbaceous, more or less elongated, in (*a*) mostly succulent and fistulous.

a. Leaflets glabrous above, or nearly so, oblong to oblanceolate, 1½′ long or more (except in *L. littoralis*); flowers subverticillate; bracts deciduous; calyx-lips usually but slightly toothed; ovules 8 or more.

6. L. Nootkatensis, Donn. Stems often stout, 1 – 2° long, more or less decumbent, leafy; pubescence densely villous, spreading or subappressed; stipules elongated, setaceous-acuminate; leaflets 6 – 8, cuneate-oblong, obtuse and mucronulate or acutish, 1½ – 2′ long, about equalling the petioles; raceme elongated, nearly sessile; bracts linear-lanceolate, equalling the calyx; flowers blue or purplish, verticillate or scattered; pedicels 2 – 6″ long; calyx large, with long setaceous bractlets, the upper lip rather deeply bifid and the lobes often erosely truncate, the lower usually strongly 3-toothed; petals 8 – 9″ long, the keel a little shorter and usually naked; ovules 9 – 12; pod 1½′ long. — From Vancouver to the Aleutian and St. Paul Islands; "Kurile Islands" (Ledebour); "Ft. Youkon" (Rothrock); Jasper House (Burke).

Var. Unalaskensis. Stems slender; pubescence wholly short, silky and appressed; raceme short and few-flowered. — Unalaska Island (Eschscholtz, Rudolphi, and Harrington); Port Mulgrave (Barclay).

7. L. polyphyllus, Lindl. Stout, erect, 2 – 5° high, sparingly villous, the pedicels, calyx, and youngest leaves silky-pubescent; stipules large, triangular to subulate; leaves distant, long-petioled; leaflets 10 – 16, in the upper leaves often but 8 – 10, glabrous above, 2 – 6′

long, ½ – 1′ wide; raceme frequently 1 – 2° long; bracts oblong-lanceolate, equalling or shorter than the calyx; flowers mostly scattered, blue, purple, or white; pedicels 3 – 6″ long; calyx-lips subequal, entire, bractlets very caducous; petals equal, 6 – 7″ long, keel naked; ovules 9; pod 1′ long or more. — From Ft. Vancouver and the Lower Fraser River to Klamath Valley and San Francisco.

8. L. WYETHII. Stem ascending, stout, ½ – 2° high, sparingly leafy; pubescence villous, spreading; stipules setaceous; leaflets 8 – 12, oblong to oblanceolate, 1½ – 2½′ long, acute, glabrous above, the lower petioles much elongated; raceme 4 – 10′ long, often long-peduncled; bracts subulate-setaceous, exceeding the calyx; flowers blue or pink, scattered or subverticillate; pedicels slender, 3 – 4″ long; calyx villous, with short setaceous bractlets, upper lip 2-toothed, the lower one longer, subentire; petals equal, 6 – 7″ long, keel naked; ovules 7 – 8. — Flathead River, Oregon (Wyeth); Clear Water (Spalding).

9. L. RIVULARIS, Dougl. Stout, erect, 2 – 6° high, branching, nearly glabrous; pubescence short and silky, close-appressed or very rarely spreading on the calyx and pedicel; stipules subulate or setaceous; leaflets 7 – 10, about equalling the petioles, ½ – 5′ long, oblanceolate, acute or the lower ones obtuse, glabrous above; raceme long-peduncled, often 1 – 2° long; bracts setaceous, exceeding the calyx; flowers scattered or subverticillate, purple or sometimes white; pedicels 2 – 5″ long; calyx with caducous bractlets, the upper lip rarely entire; petals 6″ long, equal, the keel slightly ciliate; pod 1½′ long, 8 – 10-seeded. — From the Columbia to Southern California, common. The species has been known only from the figure (*Bot. Reg.* 19, *t.* 1595) and a cultivated specimen in Herb. Lindley. These seem to accord sufficiently well with the ordinary *L. cytisoides*, Agh., and the older name is retained.

Var. LATIFOLIUS. Leaflets 5 – 7, spatulate or oblanceolate, ½ – 1½′ wide, obtuse and mucronulate, or the upper acute, the pubescence on the calyx oftener spreading.

10. L. BURKEI. Resembling the last, but distinguished by broader stipules, the lower leaves long-petioled, the raceme usually short and dense, with pedicels mostly but 1 – 2″ long, bracts villous and subpersistent, pubescence of the calyx somewhat villous and more or less spreading; pod 8-seeded. — On the east side of the Sierra; near Carson City (46 Anderson, 262 Stretch); "Snake country" (Burke); Falls of the Yellowstone (Hayden).

11. L. LITTORALIS, Dougl. Stems slender, decumbent or ascending, 1 – 2° long, often not succulent, leafy; pubescence silky, rather thin, short and appressed, or villous and spreading, especially about the linear stipules; leaflets 5 – 8, oblanceolate or cuneate-oblong, ½ – 1′ long, acute, the petioles sometimes twice longer; raceme short; bracts setaceous, exceeding the calyx; flowers blue or violet, with more or less yellow, verticillate or scattered, on pedicels 2 – 3″ long; calyx large, with small bractlets, upper lip 2-toothed; petals equal, 6″ long, keel ciliate; ovules and seeds 10 – 12; pod 1¼′ long. — Near the coast, from Washington Territory to San Francisco. Douglas was probably mistaken in saying that the root is eaten by the Indians.

b. Rather sparingly leafy, the petioles (the upper excepted) at least twice longer than the leaflets; racemes loose; bracts mostly deciduous; flowers large, not yellow; ovules 6 – 7, rarely fewer; leaflets smooth above.

12. L. PERENNIS, L. Stems 1 – 2° high, from subterranean rootstocks; pubescence minute, appressed, with some longer hairs; stipules setaceous, deciduous; leaflets 7 – 11, obovate to oblong, 1 – 2′ long, obtuse and mucronulate, or obtusish; raceme ½ – 1° long; bracts subulate, usually shorter than the calyx; flowers purplish or rarely white, scattered or subverticillate; pedicels slender, 2 – 4″ long; bractlets small; upper calyx-lip shortly toothed, the lower subentire; petals equal or the banner shorter, 5 – 7″ long, the keel ciliate; pod 1½′ long, 4″ wide, 5 – 6-seeded. — Sandy soils; Northern States and "Canada" to Wisconsin, and southward to the Gulf; Valley of the Platte (Engelmann).

Var. OCCIDENTALIS. Stem and petioles more villous. — Michigan and Wisconsin.

13. L. NUTTALLII. (*L. gracilis*, Nutt., not Agh.) Low and more slender throughout than the last, and usually villous; stipules persistent, elongated, setaceous; upper lip of the calyx more deeply toothed; flowers smaller, 4 – 5″ long; ovules 4 – 6; pod 1′ long, 3″ wide. — Georgia, Florida, and westward to Mississippi.

14. L. ARCTICUS. Villous or subglabrous; stems rather stout, 1° high or less, erect or ascending, simple; stipules conspicuous, acuminate; leaflets 6 – 8, cuneate-oblong or oblanceolate, 1 – 1½′ long, acute or obtuse, the petioles much elongated; raceme 2 – 4′ long; bracts linear, about equalling the calyx, deciduous or subpersistent; flowers

blue, subverticillate or scattered, on slender pedicels 2–3″ long; bractlets wanting or caducous; calyx-lips short, the upper entire or slightly toothed, the lower a little longer; petals 6–7″ long, the banner shorter, keel naked; ovary slightly hairy, 5–7 ovuled. — Washington Territory (Lyall); Vancouver's Island (C. B. Wood); Bear Lake (Richardson); Polar Sea (Dean and Simpson); and probably all the *L. perennis* reported from the Arctic coast.

c. Leafy and branching, the petioles not longer than the leaflets; flowers large, subverticillate, yellow in *L. Sabinii*; bracts deciduous, shorter than the calyx (except in *L. Sabinii* and *barbiger*); ovules 6–7, rarely 8.

15. L. SABINII, Dougl. Erect, 2° high; pubescence short, appressed, silky; stipules long, setaceous; leaflets 8–11, oblanceolate, 1–2½′ long, acute, silky both sides; raceme 6–10′ long, rather dense and long-peduncled; bracts linear-setaceous; pedicels 3–4″ long; calyx minutely bracteolate, upper lip shorter and shortly toothed, the lower entire; petals equal, 7–8″ long, the banner emarginate, naked, keel ciliate; ovules 7. — Collected only by Douglas in the Blue Mountains, Oregon.

16. L. ALBICAULIS, Dougl. Ascending or erect, 1–2° high; pubescence variable, short and appressed or more or less villous and spreading; stipules linear-setaceous, long or nearly obsolete; leaflets 5–9, oblanceolate or oblong, 1–2′ long, acute, pubescent both sides; raceme 4–12′ long, short-peduncled; bracts subulate; pedicels 2–3″ long; calyx large, minutely bracteolate, lips nearly equal, the upper narrowed, shortly 2-toothed, the lower subentire; petals equal, 5–7″ long, "blue-violet" or often apparently rose-color or whitish; banner acute, naked, the margins adherent at the apex; keel strongly falcate, naked; ovules 5–7; pod 1–2′ long, 4–5″ wide, 3–6-seeded. — From the Columbia to the Sacramento. No. 188 of Kellogg & Harford appears to belong here, but is unusually smooth, the leaves distant and the lower on very long petioles.

Var. BRIDGESII. The more villous form, with largest flowers and densest racemes. — Near San Francisco.

17. L. SITGREAVII. Tall, 2° high or more, branched, puberulent, and more or less silky-villous with spreading hairs; stipules setaceous; leaflets 7–9, glabrous above, oblanceolate, acute, 1–3′ long; raceme short-peduncled; upper lip of the calyx short and rather broad, shortly

toothed or nearly entire; petals 5″ long, the banner rounded, naked, the keel ciliate; ovules 5. — San Francisco Mts., Arizona (Sitgreave, 1851; Wheeler, 1872); Copper Mines, New Mexico (Bigelow). To this perhaps belongs also 2012 Brewer, from Ebbett's Pass in the Sierra, scarcely at all villous and the keel naked, as also 1020 Wright, from the mountains of New Mexico, resembling Brewer's plant, but with the stipules longer and more conspicuous.

18. L. BARBIGER. Pubescence upon the stem, pedicels and petioles dense, of short, stiffish, spreading hairs, upon the leaves and calyx silky-hairy and subappressed; stipules setaceous; leaflets 5 – 7, narrowly oblanceolate, silky on both sides; raceme rather dense, short-peduncled; pedicels 2 – 3″ long; bracts setaceous, exceeding the calyx; lower calyx-lip narrow, subentire, slightly longer than the broader rather deeply toothed upper lip; petals 5″ long, ochroleucous, equal, the banner rounded, silky, the keel copiously ciliate; ovules 7. — Collected in Kane County, Southern Utah, 1873, by A. L. Siler.

19. L. ORNATUS, Dougl. Stems decumbent or ascending; pubescence usually short, more or less silky, mostly appressed; stipules setaceous; leaflets 5 – 7, oblanceolate or cuneate-oblong, ¾ – 2′ long, acute or acutish; raceme 3 – 8′ long, usually short-peduncled; bracts short, subulate or ovate; pedicels 2 – 3″ long; bractlets setaceous; calyx-lips nearly equal, the upper rather shortly toothed or bifid, the lower subentire; petals blue, equal, 5 – 7″ long, the banner acutish, subsilky on the back, keel ciliate; ovules 5 – 8; pod 1¼′ long, 3 – 4″ wide. — From the Columbia River to Southern California.

L. leucopsis, Agh., collected by Douglas in "Oregon and Rocky Mts.," appears to be the same. Specimens from Clark's Ranch, Mariposa Valley (Dr. Gray), may probably be referred here as an extreme form, being densely tomentose, the leaflets nearly obovate, and banner but slightly bearded.

Var. GLABRATUS. Leaflets glabrous above, cuneate-oblong, acutish or obtuse; flowers nearly white, with a dark-purple spot upon the banner. — Common in the Rocky Mountains of Colorado.

d. Leaves distant; lower petioles elongated; leaflets not smooth above; racemes mostly dense; flowers smaller and not yellow (except in *L. sulphureus*); ovules 4 – 6.

20. L. SULPHUREUS, Dougl. A not fully identified species. Described as with 13 – 15 densely silky leaflets, keel naked and banner

subglabrous. Nothing in our herbariums accords with this. A specimen collected by Spalding, and noted by Dr. Gray as the same as Douglas's plant in the Kew herbarium, has ascending sparingly leafy stems, 1½° high; pubescence silky, loosely appressed; leaflets 8 – 10, acute, 1 – 2′ long, narrowly lanceolate; raceme rather dense, peduncled; bracts deciduous; flowers subverticillate; pedicels 1 – 2″ long; calyx short and short-lipped, the upper lip slightly 2-toothed; petals 4 – 5″ long, apparently yellow, the banner slightly hairy and keel ciliate; ovules 4 – 5.

A specimen of Wyeth's from "Medicine Clay Prairie," noted as "pale-yellow with a dark spot in the centre of the vexillum," much resembles this, but has flowers 6 – 7″ long, slender pedicels, and the banner naked. Another very similar plant of Douglas's, from the junction of Lewis's and Clark's rivers, named *L. sericeus* in herb. Bentham, has also longer and more slender pedicels, longer calyx-lobes, the banner naked, and the leaves more numerous and with shorter petioles. Still another specimen of Douglas's from "Oregon or Rocky Mts.," referred to *L. sericeus* in Torr. & Gray's Flora, has both banner and keel naked. These are both apparently yellow.

21. L. SERICEUS, Pursh. Rather stout, suberect, 1 – 2° high; pubescence more or less coarsely villous or subsilky, spreading; stipules usually long-setaceous; leaflets 5 – 8, rarely 10, narrowly oblanceolate, 1 – 2½′ long, acute; racemes short-peduncled; bracts deciduous, subulate-setaceous, often much exceeding the calyx; flowers subverticillate or scattered, on short pedicels, blue or ochroleucous; calyx strongly gibbous but scarcely saccate, minutely bracteolate, densely silky-villous, lips nearly equal, the upper slightly toothed, the lower subentire; petals equal, 6″ long, banner hairy, keel ciliate; ovules 4 – 5; pod densely hairy, 1′ long. — Oregon to Northern Nevada and the Wahsatch.

22. L. LEUCOPHYLLUS, Dougl. Stout, 2 – 3° high, leafy, densely silky-tomentose throughout; stipules long-setaceous or subulate; leaflets 7 – 10, oblanceolate or cuneate-oblong, 1 – 2½′ long, acute, the petioles about equalling the leaves or the lower twice longer; raceme dense, 6 – 12′ long, sessile or nearly so; bracts subulate or linear, shorter or longer than the calyx, subpersistent or deciduous; flowers scattered or subverticillate, nearly sessile; bractlets small, setaceous or oblong-subulate; upper calyx-lip rather broad, more or less deeply 2-cleft, the lower slightly longer, subentire; petals blue or pink, equal, 4 – 6″ long,

banner densely villous, keel naked or ciliate; ovules 5 – 6. — From the Cascade Mts. of Oregon and Washington Territory eastward to Utah and New Mexico.

23. L. Palmeri. Densely rough-pubescent with rather rigid, straight, spreading hairs, more appressed upon the leaves; stipules very small; leaflets 6 – 8, oblanceolate, acute, ½ – 1′ long, the petioles 3 – 4 times longer; raceme peduncled, rather loose; bracts subulate, shorter than the calyx, deciduous; flowers scattered or subverticillate, on pedicels 1″ long; calyx with broad subequal lips, the upper 2-toothed, the lower subentire and mostly erect; petals 4 – 5″ long, equal, deep-blue, the broad banner with a dark spot in the centre, somewhat hairy on the back; keel naked; ovules 5 – 6. — San Francisco Mts., Arizona (Dr. E. Palmer).

24. L. lepidus, Dougl. Slender, 9′ – 2° high, leafy at base, densely appressed-silky; stipules setaceous; leaflets 7 – 9, narrowly oblanceolate, ¾ – 1½′ long, acute, petioles much elongated; raceme 2 – 8′ long; bracts not exceeding the calyx, caducous; flowers in near verticils or scattered, pedicels 1 – 2″ long; upper calyx-lip 2-toothed or deeply cleft, the lower 3-toothed or subentire; petals violet, whiter at base, equal, 5″ long, the keel ciliate; ovules 4 – 6; pod 1′ long. — Washington Territory and Oregon, from Puget Sound to Klamath Lakes.

25. L. confertus, Kellogg. Erect or ascending, 1° high or more, branching; pubescence silky-villous, appressed or spreading; leaflets 5 – 8, cuneate-oblong to narrowly oblanceolate, ¾ – 1¾′ long, acute; raceme usually dense, 2 – 9′ long, rather long-peduncled; bracts persistent, about equalling the calyx, setaceous; flowers verticillate, nearly sessile; upper calyx-lip 2-cleft, lower slightly 3-toothed; petals equal, blue or pink, 4 – 5″ long, the banner rather narrow, keel ciliate; ovules 4 – 6; pod ¾′ long, 2 – 4-seeded. — In the Sierra, from Yosemite Valley to Washoe Lake and Donner Pass.

e. Stems leafy; petioles short; racemes short-peduncled; bracts deciduous, mostly short; flowers usually small, not yellow; ovules 3 – 5.

26. L. flexuosus, Lindl. Stems ascending or decumbent, 1½° high, branching; pubescence short, silky, and appressed, or subvillous on the leaves; stipules linear-setaceous; leaflets 6 – 8, oblanceolate, 1 – 1½′ long, acute, silky on both sides; raceme 3 – 6′ long or more; bracts lanceolate-setaceous, equalling or much exceeding the calyx; flowers subverticillate, pedicels 2 – 3″ long; calyx-lips nearly equal,

the upper slightly toothed, the lower subentire; bractlets short, setaceous; petals apparently blue or flesh-color, equal, 5″ long, banner very hairy, keel strongly ciliate; ovules 5 – 4; pod 1′ long. — Columbia Valley.

27. L. Andersoni, Watson. About 1° high, slender, much branched and leafy, minutely pubescent; stipules small, subulate; leaflets 7 – 9, oblanceolate, ¾ – 1¼′ long, acute or obtuse and mucronulate, pubescent both sides; raceme becoming 6′ long; flowers subverticillate or scattered, pedicels 1 – 2″ long; calyx campanulate, not at all saccate, obscurely bracteolate, lips subequal, upper broad and shortly toothed, lower subentire; petals blue or pink, equal, 4″ long; banner and keel naked; ovules 5 – 6; pod pubescent, 1¼′ long. — In the Sierra Nevada, near Carson City (Anderson).

Var. (?) Grayi. Leaflets obovate, 6 – 9″ long, obtuse or emarginate, mucronulate; the whole plant densely silky-villous. — Clark's Ranch, Mariposa Valley, California (Dr. Gray).

28. L. parviflorus, Nutt. Strict, erect, slender, 2 – 3° high, at length branching; pubescence scanty, short, appressed, the calyx and pedicels silky; stipules setaceous; leaves rather distant; leaflets 5 – 11, oblanceolate to obovate, 1 – 2′ long, acute or obtuse and mucronulate, glabrous above, the lower leaves shorter than the petioles; raceme ½ – 1° long, slender; bracts linear-subulate, equalling the calyx; flowers subverticillate or scattered, the slender pedicels 1 – 2″ long; calyx-lips nearly equal, the upper 2-toothed; petals light-blue, equal, 3 – 4″ long, keel ciliate or naked; pod ¾′ long, 2 – 4-seeded, pubescent. — In the mountains from the Columbia River to Northern Utah and the Yosemite Valley. Stems usually solitary, the root-stock probably creeping.

29. L. calcaratus, Kellogg. Stems rather stout, 1 – 2° high, ascending, branched, puberulent; leaves more or less silky on both sides; stipules subulate or setaceous; leaflets 6 – 12 (about 9), oblanceolate, 1 – 2′ long, acute, at least half as long as the petioles; racemes 3 – 6′ long; bracts subulate; flowers verticillate or scattered, on pedicels 1 – 3″ long; calyx silky-pubescent, conspicuously spurred, upper lip shortly toothed, the lower subentire, a little longer; bractlets small, setaceous; petals white or blue, the banner pubescent, 6″ long, exceeding the wings and ciliate keel; ovules 4 – 6; pod ¾ – 1′ long, hairy. — Northern Nevada and eastern slope of the Sierra.

30. L. laxiflorus, Dougl. Ascending or erect, 1 – 2° high, slen-

der; pubescence minute, silky, appressed; stipules setaceous, mostly very small; leaflets 6 – 8, narrowly oblanceolate, 1 – 2′ long, acute, puberulent on both sides, at least half as long as the petioles; racemes loose and slender, 3 – 6′ long; bracts subulate; flowers subverticillate or scattered, small, on pedicels 2 – 3″ long; calyx narrowed and saccate at base, minutely bracteolate, upper lip shortly toothed, the lower subentire and a little longer; petals blue, 3 – 5″ long, equal; banner subpubescent, keel ciliate; ovules 4 – 6; pod $\frac{3}{4}$′ long, very hairy. — Washington Territory and Oregon, from Ft. Vancouver to Klamath Valley and the northern Sierra, and eastward to Northern Utah. *L. arbustus*, Dougl., is a rather stouter, larger-leaved form, the leaflets sometimes 2$\frac{1}{2}$′ long.

31. L. ARGENTEUS, Pursh. Erect or ascending, 1 – 2° high, slender; pubescence minute, silky, appressed; stipules small; leaflets 5 – 8, linear-lanceolate, $\frac{3}{4}$ – 1$\frac{1}{2}$′ long, acute, smooth above or nearly so, about equalling the petioles; racemes 2 – 6′ long, nearly sessile; flowers subverticillate or scattered, pedicels $\frac{1}{2}$ – 2″ long; calyx campanulate, gibbous but not spurred at base, minutely bracteolate, upper lip broad, 2-toothed, the lower subentire, slightly longer; petals blue or cream-colored, equal, 3 – 4″ long, the banner very broad, naked or subhairy, keel naked or subciliate; ovules 5 – 3; pod $\frac{3}{4}$ – 1′ long. — Plains of the Columbia and Snake Rivers. Distinguished from the last chiefly by the shape of the calyx and smoother leaves; including its varieties, this is the most widely diffused of the western species.

Var. DECUMBENS. (*L. decumbens*, Torr.) Raceme dense and many-flowered; stem usually stouter and more leafy. — In the Rocky Mts., from Montana to New Mexico.

Var. ARGOPHYLLUS. With the habit of var. *decumbens*, but more copiously silky-pubescent, the leaflets nearly or quite equally so upon both sides, longer than the petioles; flowers larger, 5 – 6″ long, blue or ochroleucous, the calyx decidedly spurred. Approaching nearly to *L. laxiflorus*. — Montana to New Mexico.

32. L. HOLOSERICEUS, Nutt. Erect or ascending, 1 – 1$\frac{1}{2}$° high; pubescence silvery-silky, closely appressed; stipules short; leaflets 6 – 8, narrowly oblanceolate, $\frac{3}{4}$ – 1$\frac{1}{4}$′ long, acute, very silky both sides, at least half as long as the petioles; racemes 3 – 6′ long, nearly sessile; flowers often very small, verticillate, pedicels 1 – 2″ long; calyx slightly spurred at base, minutely bracteolate, lips nearly equal, the upper broad and shortly toothed, lower subentire; petals apparently

flesh-color, 2 – 5″ long, equal or the banner longer; banner very broad, pubescent on the back; keel ciliate; ovules 4 – 3; pod 1′ long. — Columbia Valley (Nuttall), and southward east of the Sierra to Southern Nevada.

Var. UTAHENSIS. Stouter; the leaflets oblong-lanceolate, 1 – 1¾′ long, 3 – 6″ wide. — Mountains of Northern Utah.

33. L. MEIONANTHUS, Gray. Ascending or erect, 1° high; pubescence dense, silky-tomentose; stipules minute; leaflets 5 – 7, oblong to oblanceolate, ¾ – 1′ long, acutish, silky both sides, about equalling the petioles; racemes short and small, scarcely peduncled; bracts ovate; flowers very small, subverticillate, on pedicels ½ – 1″ long; calyx campanulate, not spurred, densely tomentose, very obscurely bracteolate, lips nearly equal, the upper broad and toothed with a wide sinus, the lower subentire; petals blue, equal, 2″ long, scarcely exceeding the calyx, banner very broad, naked, keel slightly ciliate; ovules 3 – 4; pod ½′ long, 3″ broad. — Collected only by Anderson, Carson City, Nevada.

† † † Dwarf, short-stemmed and mostly cæspitose; racemes mostly short and dense; bracts subpersistent; flowers subverticillate, short-pedicelled; calyx with the upper lip 2-cleft (or 2-toothed in *L. aridus*), the lower 3-toothed; keel ciliate; ovules 3 – 6; pod hairy, 3 – 4-seeded (1 – 2-seeded in *L. Kingii*).

34. L. CÆSPITOSUS, Nutt. Stems very short and cæspitose; pubescence dense, villous, appressed; leaflets 5 – 7, oblanceolate, ½ – 1′ long, acute, the petioles thrice longer; racemes sessile, shorter than the leaves; bracts setaceous, exceeding the calyx; petals pale-blue, equal, 3 – 4″ long, the banner narrow, 2″ broad; pod ½′ long.—Rocky Mountains of Colorado and "Oregon" (Nuttall).

35. L. ARIDUS, Dougl. Stems cæspitose, 2 – 3′ long, with rather long internodes; pubescence villous, loose, and appressed; leaflets 5 – 7, oblanceolate, acute, ¾ – 1′ long, the petioles 3 – 4 times longer; raceme dense, 2 – 3′ long, the peduncle shorter than the leaves; bracts nearly equalling the calyx; upper calyx-lip shortly toothed, the lower subentire; petals purple, 5″ long, nearly twice longer than the calyx, the elliptical banner usually shorter; pod 5″ long, very hairy. — Washington Territory and Oregon.

Var. LOBBII. (*L. Lobbii*, Gray MS. in herb.) Differing chiefly in the more strongly toothed lips of the calyx; peduncles exceeding the leaves; leaflets obovate or oblanceolate, ½′ long, the petioles 2 – 3 times longer; banner broader.—Intermediate between *L. aridus* and *L. minimus*. In the high Sierras of California.

Var. UTAHENSIS. Racemes 3 – 6′ long, shorter than the very long-petioled leaves; bracts setaceous, exceeding the flowers; petals purplish, 4″ long, the banner shorter.— Parley's Park in the Wahsatch (Watson).

36. L. KINGII. Stems apparently from a perennial subterranean rootstock, diffusely branched, leafy; pubescence villous, spreading; leaflets oblong-lanceolate, $\frac{3}{4}$ – 1′ long, acutish or obtuse, the petioles twice longer; racemes on slender peduncles equalling the leaves; bracts short; calyx nearly equalling the petals, the lower lip equally 3-toothed; petals purplish, 4″ long, the narrow rhomboidal banner shorter than the wings; ovules 2 – 3; pod ovate, 5″ long, 1 – 2-seeded. — Heber Valley in the Wahsatch (Watson). At first mistaken for the last, which it much resembles.

37. L. MINIMUS, Dougl. Appressed silky-villous, 3 – 6′ high; leaflets 5 – 9, obovate or oblanceolate, 3 – 8″ long, mostly acutish, the petioles 3 – 4 times longer; peduncles equalling or exceeding the leaves; bracts short, deciduous; calyx half the length of the petals, upper lip deeply bifid; petals purple, 4 – 5″ long, equal, the banner orbicular.—Oregon and Washington Territory.

38. L. BREWERI, Gray. Stems 2 – 6′ long, from a spreading branched woody caudex, very leafy; pubescence dense, silky, appressed; leaflets 7 – 10, obovate, obtuse, 4 – 6″ long, the petioles 1 – 2 times longer; racemes very short, peduncles equalling the leaves; bracts short; calyx-lips nearly equal, the upper deeply bifid, the lower shortly and equally toothed; petals blue, equal, 3 – 4″ long, the banner orbicular. — Sierra Nevada, California; alpine.

39. L. LYALLII, Gray. Stems leafy, from a spreading woody caudex; pubescence dense, villous, appressed; leaflets 5 – 6, obovate, 3 – 4″ long, acutish, the petioles 3 – 4 times longer; racemes very short, the peduncles much exceeding the leaves; bracts short; calyx-lips nearly equal; petals purple, 5″ long, nearly equal, the banner elliptical. — Summit of the Cascade Mountains, Washington Territory (Lyall).

Var. DANAUS. (*L. Danaus*, Gray.) Stems less leafy; pubescence rather sparse; petals nearly white, the keel tipped with dark-purple. — Mt. Dana, California, at 12,500 feet altitude. The comparison of a larger amount of material may modify the definition of some of these alpine species.

* * * Annuals, erect; leaflets mostly 5 – 7 (in *L. leptophyllus*, 8 – 10); upper calyx-lip 2-parted or bifid; keel mostly ciliate.

† Flowers verticillate; bracts deciduous.

40. L. AFFINIS, Agh. Pubescent with very short spreading or subappressed hairs, 1° high, branched; leaflets broadly cuneate-obovate, 1′ long, emarginate or rounded at the apex, glabrous or smoother above, half as long as the petioles; racemes long-peduncled; bracts short; lower calyx-lip entire or equally 3-toothed; petals 5″ long, nearly equal, bluish-purple and white, the keel usually naked; ovules 5 – 9; pod 1 – 1½′ long. — From San Francisco to San Diego; an early spring flower. Near the larger flowered form of *L. nanus*, with which it was confounded by Agardh himself, but distinguished by its short pubescence, broader and obtuser leaflets, usually smooth above, and its short bracts. *L. cervinus*, Kellogg, is probably only a stout form of this species.

41. L. NANUS, Dougl. Slender, ½ – 1° high, branching often from the base, villous with spreading hairs or only short-pubescent; leaflets linear to oblanceolate, ½ – 1′ long, acute, pubescent on both sides, the petioles 1 – 3 times longer; racemes loose, 2 – 6′ long; bracts mostly exceeding the calyx and attenuate; pedicels slender, 2 – 3″ long; upper calyx-lip 2-cleft, the lower entire or slightly toothed; petals 3 – 6″ (usually 5 – 6″) long, very broad, bluish-purple, the banner at first nearly white, spotted with dark-purple lines, the white turning to reddish-purple; ovules 6 – 9; pod ½ – 1¼′ long, 4 – 8-seeded. — From Sacramento Valley to Southern California and Western Arizona. Flowering in spring; quite variable in the size of its flowers and breadth of the leaflets.

42. L. MICRANTHUS, Dougl. Near the last; slender, branching from the base, 3 – 12′ high, villous; leaflets linear, ¼ – 1′ long; racemes short, usually rather crowded; bracts shorter than the calyx; pedicels ½ – 1″ long; calyx-lips broad, the upper with two short triangular lobes, the lower obtuse and subentire or slightly toothed; petals 2 – 3″ long, the wings and banner very narrow. — From Puget Sound to Southern California.

Var. MICROPHYLLUS. (*L. microphyllus*, Nutt. MS.) A lower and more hirsute form, with leaflets but 3 – 6″ long. San Diego.

Var. TRIFIDUS. (*L. trifidus*, Torr. MS.) Very hairy; lower lip of the calyx 3-parted. — Found near San Francisco by several collectors, and perhaps a good species, though the only apparent characteristic is the remarkable division of the calyx.

Var. BICOLOR. (*L. bicolor*, Lindl.) The flowers a little larger, with somewhat broader petals, the pedicels 1 – 2″ long. Varying towards *L. nanus* and tending to unite the species.

† † Flowers scattered; bracts more or less persistent (except in Nos. 43, 47, and 48); ovules 4 – 6 (in *L. truncatus*, 8).

43. L. LEPTOPHYLLUS, Benth. Slender, 1 – 2° high, villous with both appressed and spreading rather rigid hairs; stipules linear-setaceous; leaflets 8 – 10, narrowly linear, 1 – 1½′ long, glabrous above, the very slender petioles 2 – 3 times longer; racemes becoming loose, 3 – 10′ long; bracts setaceous, much exceeding the calyx; pedicels 2 – 3″ long; upper calyx-lip narrow, deeply cleft; petals 5 – 6″ long, "bluish-lilac, with a deep-crimson spot on the banner"; pod narrow. — Hills and rocky places; Sacramento Valley and southward. A somewhat broader leaved form occurs.

44. L. SPARSIFLORUS, Benth. Very slender, 1 – 1½° high; villous with spreading hairs; upper leaves much reduced; leaflets 5 – 9, linear, ¼ – 1′ long, the very slender petioles 2 – 4 times longer; raceme 3 – 6′ long; bracts linear-setaceous, shorter than the calyx, subpersistent; pedicels 1 – 2″ long; upper calyx-lip 2-parted, lower entire; petals violet, 5″ long, the banner shorter; pod ½ – 1′ long. — Sacramento Valley to Southern California; spring.

45. L. TRUNCATUS, Nutt. Slender, 1 – 2° high, finely pubescent, becoming nearly glabrous; stipules short, subulate; leaflets 5 – 7, linear, attenuated from the truncate or sub-3-toothed apex to the base, ¾ – 1½′ long, smooth above, the petioles but little longer; raceme 3 – 6′ long; bracts short, linear-subulate, subpersistent; pedicels ½ – 2″ long; upper calyx-lip 2-cleft, the lower subentire; petals deep-purple, 4 – 5″ long, the banner shorter; pod 1¼′ long. — California, from San Francisco to San Diego; spring.

46. L. SUBCARNOSUS, Hook. Rather stout, 1° high, silky-pubescent; leaflets 5, cuneate-obovate, acute or rounded or retuse at the apex, ¾ – 1½′ long, usually glabrous above, the petioles 2 – 3 times longer; racemes 2 – 3′ long, elongating in fruit; bracts lanceolate, short, subpersistent; pedicels slender, 2 – 4″ long; upper calyx-lip 2-cleft, the lower subentire; petals blue, 4 – 5″ long, the banner with a white or yellow centre; pods 1½′ long, 4 – 6-seeded. — Texas; spring. Including *L. Texensis*, Hook. The typical form (142 Drummond) is the more densely pubescent state, the leaves not glabrous above and the flowers smaller.

47. L. Stiveri, Kellogg. Diffusely branched, ½ – 1° high, finely and rather sparingly pubescent; leaflets 5 – 7, broadly cuneate-obovate, ½ – 1½′ long, rounded or acutish at the apex, mucronulate, scarcely smoother above, the petioles but little longer; raceme 2 – 3′ long, 5 – 10-flowered, rather long-peduncled; bracts short, subulate; pedicels 1 – 2″ long; calyx silky-pubescent, minutely bracteolate, upper lip parted, the ovate acute lobes nearly equalling the broad entire lower lip; petals 6 – 7″ long, the yellow banner shorter than the rose-colored wings; pod slightly puberulent or glabrous, 1′ long. — In the Sierra Nevada, from Bear Valley to the Yosemite; a handsome and well-marked species.

48. L. hirsutissimus, Benth. Rather stout, 1° high or more, very hirsute with spreading, straight, and viscid "stinging" hairs; leaflets 5 – 7, broadly cuneate-obovate, rounded or retuse or sometimes acute at the apex, mucronulate, ¾ – 1½′ long, half as long as the petioles; racemes loose, 3 – 8′ long; bracts short, subulate, usually deciduous; pedicels 1 – 2″ long; calyx large, upper lip broad, deeply cleft, shorter than the lower; petals 6″ long, nearly equal, reddish-purple; pod hirsute, 1′ long. — Dry places from Sacramento Valley to Southern California; January to March. Specimens collected by Dr. Bigelow on Whipple's Exploration in Western Arizona, with shorter, less rigid, and more appressed hairs and acute linear-lanceolate leaves, may perhaps be referred here.

49. L. concinnus, Agh. Low, 4 – 6′ high, densely villous or hirsute, with long spreading hairs; leaflets 5 – 8, oblanceolate, 4 – 10″ long, obtuse, the slender petioles 2 – 4 times longer; raceme 1 – 2′ long, peduncled or nearly sessile; bracts short, linear-setaceous, persistent; pedicels very short; upper calyx-lip parted, the lower rather deeply trifid, narrow; petals 4″ long, "violet with a yellow spot on the banner," the banner shorter; pod 4-seeded. — From Monterey southward, Sonora and New Mexico; rarely collected.

Var. Arizonicus. Rather stout, ½ – 1° high, more sparingly hirsute with spreading hairs; leaflets cuneate-obovate, obtuse or acutish; raceme 2 – 6′ long; petals 3 – 4″ long, equal, ochroleucous or tipped with violet; pod ½′ long, 3 – 5-seeded. — Southeastern California and Western Arizona.

50. L. gracilis, Agh. Low, 3 – 6′ high, slender, very hirsute; leaflets 5 – 7, cuneate-obovate, 3 – 6″ long, the slender petioles 2 – 3 times longer; raceme short, loose, flexuous; bracts short; pedicels less

than 1″ long; petals "blue and white," 2 – 3″ long, narrow, the banner slightly shorter, the calyx and petals nearly as in *L. micranthus;* pod ½′ long, 4 – 5-seeded. — From Monterey to Southern California.

§ 2. PLATYCARPOS. Flowers as in § *Lupinus;* ovules 2; cotyledons broad and clasping after germination, usually long-persistent. — Annuals; leaflets several, cuneate-oblong or -obovate; bracts persistent; pods ovate.

* Flowers verticillate; stems tall; racemes long-peduncled.

51. L. MICROCARPUS, Sims. Villous with long spreading hairs, ½ – 1½° high; stipules long, setaceous; leaves mostly approximate upon the stem, on elongated petioles; leaflets 7 – 11, usually 9, cuneate-oblong, 1 – 2′ long, obtuse and mucronulate or emarginate, or sometimes acutish, smooth above; flowers in close verticils, on pedicels 1 – 2″ long; bracts subulate-setaceous, equalling the calyx or shorter; calyx densely villous, lower lip large, 3-toothed, the middle tooth small, the upper lip very short, subscarious, toothed; bractlets small, often wanting; petals purple, or sometimes flesh- or cream-colored or white, 6 – 7″ long, equal, the keel slightly ciliate; pods villous, 8″ long. — From the Columbia River to Southern California; stouter than most Chilian specimens. It occasionally approaches closely to the next in pubescence and in the color of the flowers.

52. L. DENSIFLORUS, Benth. Much resembling the last, but more sparingly villous with shorter hairs; bracts much shorter than the calyx, which is smooth or short-pubescent, the upper lip often entire; petals yellow, or ochroleucous, white or pink. — From the Sacramento Valley southward. It includes *L. Menziesii*, Agh.; and *L. succulentus*, Koch, is probably but a garden form.

53. L. BRIDGESII, Gray, MS. in herb. Stem 1 – 2° high, rather slender, branched; pubescence short, appressed, subsilky, the bracts and pod villous; stipules short; leaves scattered; petioles short; leaflets 5 – 9, usually 7, cuneate-oblong, 1′ long, obtuse or acute, pubescent both sides or sometimes smooth above; bracts linear-setaceous, exceeding the calyx; flowers as in the last, the petals pale-yellow, 6″ long. — Sacramento Valley. Collected by Bridges (55), Bolander (6512), and Dr. Kellogg.

* * Low; flowers scattered; bracts shorter than the calyx.

54. L. PUSILLUS, Pursh. Rather stout, 3 – 10′ high, diffusely branched, hirsute with long spreading hairs; leaflets usually 5, cuneate-

oblong or -oblanceolate, ¾ – 1¼′ long, acute or obtuse, nearly glabrous above, about half as long as the petioles; racemes short-peduncled or sessile, 2 – 3′ long; pedicels 2 – 3″ long; bractlets minute; upper calyx-lip 2-cleft, the lower subentire; petals purple or rose-color, 4″ long, equal; pods ½ – ¾′ long; seed nearly 2″ wide. — From the Missouri to the Columbia and southward, east of the Sierra, to New Mexico and Arizona.

55. L. BREVICAULIS, Watson. Less hairy; stems short or nearly wanting, 1 – 4′ high; leaflets mostly 7, cuneate-obovate, 5 – 8″ long, rounded at the apex; racemes dense, 1 – 2′ long, the peduncles nearly equalling the leaves; pedicels 1 – 2″ long in fruit; bractlets small; upper calyx-lip very short or truncate, scarious, the lower subentire; petals blue, 3 – 5″ long, equal; pod 3 – 5″ long; seed about 1″ broad. — From Northern Nevada to Arizona and Western New Mexico.

§ 3. LUPINELLUS. Flowers axillary, solitary; sides of the banner scarcely at all reflexed; keel nearly straight; pod ovate; ovules 2. — A dwarf diffusely branched villous annual.

56. L. UNCIALIS, Watson. Less than 1′ high, very leafy; leaflets 5, cuneate-oblong, 2″ long, obtuse, the petioles 2 – 3 times longer; stipules obtuse; peduncles axillary, equalling the leaves or shorter, the bract short and oval; calyx ebracteolate, upper lip short, deeply cleft, the lower 3-toothed, the middle tooth very small; petals ochroleucous, 1½″ long, the banner shorter and obovate, acute, the keel tipped with purple, not beaked, obtuse; pod 2″ long, hairy. — Northwestern Nevada.

SYNONOMY,

WITH COLLECTORS' NAMES AND NUMBERS, SO FAR AS VERIFIED.

40. LUPINUS AFFINIS. Agardh, Synopsis Lup., 20, in part. Hook. & Arn., Bot. Beech., 335.* Torr. & Gray, Flora, 1. 376. Dietrich, Syn. Veg., 4. 940. Bolander, Cat. Pl. San Franc., 8. — Nos. 382, 387, 388, 389, 391 Coulter.

? *L. cervinus.* Kellogg, Proc. Acad. Calif., 2. 229, **fig. 73.**

16. LUPINUS ALBICAULIS. Douglas in Hook. Fl. Bor. Am., 1. 165. Don's Mill., 2. 366. Agardh, Syn., 29. Torr. & Gray, Flora, 1. 378. Dietr., Syn., 1. 942. Durand, Pl. Pratten., 86. Boland., Cat. Pl. San Franc., 8. — No. 58 Bridges; 84 Torrey; 89 Hall; Douglas; Nuttall; Wilkes; Bigelow; Pratten; Shelton.

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* References in *old style* numerals indicate only a mention of the species, without description or notes of special interest.

L. Mexicanus. Torrey in Sitgreave's Rep., 158; not Lag.

L. laxiflorus. Torrey, Pac. Railroad Rep., 4. 81; not Dougl.

L. foliosus. Nutt., MS. in herb. Gray in Proc. Amer. Acad., 8. 379.

Var. Bridgesii. — Nos. 64, 64 a Bridges; 2644 Bolander; 857, 2540 Brewer.

4. Lupinus albifrons. Bentham, Trans. Hort. Soc., n. s., 1. 410. Lindl., Bot. Reg., 19, t. 1642; (Lit. Ber. zu Linnæa, 1835, 30.) Agh., Syn., 33. Torr. & Gray, Flora, 1. 380. Hook. & Arn., Bot. Beech., 336. Dietr., Syn., 4. 942. Benth., Pl. Hartweg., 303. Torrey, Pac. R. R. Rep., 4. 81; Bot. Mex. Bound., 57. Newberry, Pac. R. R. Rep., 6. 70. Boland., Cat. Pl., 8. — No. 1688 Hartweg; 394 - 396 Coulter; 63 ("37") Bridges; "262 Lobb"; 112, 129, 262 Fremont; 507, 615 Thurber; 2365 Bolander; 570, 571, 644, 703, 1038 Brewer; 85 Torrey; 184 Kellogg & Harford; 93 Hall; Nuttall; Bigelow; Parry; Fitch; Peckham.

L. Chamissonis. Esch., Mem. Acad. Petr., 10. 288; (Lit. Ber. zu Linnæa, 1828, 151.) Presl., Repert. Bot., 1. 198. Hook. & Arn., Bot. Beech., 336.

L. sericeus. Hook. & Arn., Bot. Beech., 138; not Pursh.

L. ornatus. Torrey, Pac. R. R. Rep., 4. 81; not Dougl.

L. littoralis. Torrey, Bot. Mex. Bound., 58; not Dougl.

L. holosericeus. Gray, Proc. Amer. Acad., 8. 379; not Nuttall.

27. Lupinus Andersoni. Watson, King's Rep., 5. 58. — Nos. 9, 108, 121 Anderson; Gray.

3. Lupinus arboreus. Sims, Bot. Mag., t. 682. Willd., Enum., 752. Persoon. Poiret. DC. Prodr., 2. 409. Sprengel, Syst. Veg. Don. Dietrich. Agardh, Syn., 25. Lindl., Bot. Reg., 24, t. 32. Benth., Pl. Hartw., 303. Torrey, Bot. Mex. Bound., 57. Boland., Cat., 8. — No. 1689 Hartweg; 380 Coulter; 61 Bridges; 402 Bolander; 641 Brewer; 86 Torrey; 182 Kell. & Harf.; Douglas; Wright; Parry; Gibbons; Shelton.

L. sericeus. Esch., Mem. Acad. Petr., 10. 289; not Pursh.

L. arboreus, var. *odoratissimus.* Fisch. & Mey., Ind. Sem. h. Petr., 2. 16.

L. rivularis. Agh., Syn., 24; not Dougl. Torr. & Gray, Flora, 1. 376, mostly. Hook. & Arn., Bot. Beech., 335. Dietr., Syn., 4. 941. Durand, Pl. Pratten., 86. Torrey, Bot. Mex. Bound., 57.

L. macrocarpus. Hook. & Arn., Bot. Beech., 138. Torr. & Gray, Flora, 1. 381. Dietr., Syn., 4. 943. Newberry, Pac. R. R. Rep., 6. 71.

14. Lupinus arcticus. — Richardson; Dean & Simpson; Lyall; Wood.

L. perennis. Richards., Frankl. 1st Voy., Appx. 17; not Linn. Hook., Fl. Bor. Am., 1. 163, in part. Hook. & Arn., Bot. Beech., 123. Ledebour, Fl. Ross., 1. 511. Seemann, Bot. Herald, 28 and 51. Hook. f., Distrib. Arc. Plants, 289. Rothrock, Fl. Alaska, 445.

31. Lupinus argenteus. Pursh, Flora, 468. DC. Prodr., 2. 408. Sprengel, Syst., 3. 227. Hook., Fl. Bor. Am., 1. 164. Don's Mill., 2. 367. Torr. & Gray, Flora, 1. 377, in part. — Douglas; Nuttall; Tolmie; Burke; Newberry.

L. tenellus. Douglas, Don's Mill., 2. 367. Agh., Syn., 27.

L. laxiflorus, var. *tenellus.* Torr. & Gray, Flora, 1. 377. Porter, Hayden's Rep., 1871, 480.

L. laxiflorus, var. *foliosus.* Torr. & Gray, Flora, 1. 377.

L. ornatus. Newberry, Pac. R. R. Rep., 6 70; not Dougl.

Var. DECUMBENS. — Nos. 167, 168 Fendler; 29 Geyer; 200 Parry; 47 Anderson; 104 a Vasey; James; Fremont; Abert; Hulse; Palmer; Hayden; Canby.

L. decumbens. Torrey, Ann. N. Y. Lyc., 2. 191. Don's Mill., 2. 367. Torr. & Gray, Flora, 1. 381. Dietr., Syn., 4. 943. Gray, Pl. Fendl., 38. Engelm., Pl. Upp. Miss., 190. Porter, Hayden's Rep., 1870, 474.

L. laxiflorus. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 215; not Dougl. Gray, Pl. Fendl., 38; Pl. Parry in Sill. Journ., 1862, 22.

L. ornatus. Torrey, Fremont's Rep., 89, mostly; not Dougl.

Var. ARGOPHYLLUS. — 166, 167 Fendler; Fremont; Bigelow.

L. decumbens, var. *argophyllus.* Gray, Pl. Fendl., 37. Torrey, Pac. R. R. Rep., 4. 81. Durand, Fl. Utah, 163?

L. ornatus. Torrey, Fremont's Rep., 89, in part; not Dougl.

35. LUPINUS ARIDUS. Dougl., Lindl. Bot. Reg., 15, **t. 1242.** Hook., Fl. Bor. Am., 1. 165. Don's Mill., 2. 367. Agh., Syn., 31. Torr. & Gray, Flora, 1. 379. Dietr., Syn., 4. 942. Boland., Cat., 8. — Douglas; Lyall.

Var. LOBBII. — "No. 264 Lobb"; 1894, 2085 Brewer.

Var. UTAHENSIS. — No. 234 Watson, in part.

L. aridus (?) Watson, King's Rep. 5. 57, in part.

18. LUPINUS BARBIGER. — Siler.

55. LUPINUS BREVICAULIS. Watson, King's Rep., 5. 53, **t. 7.** — No. 335 Thurber; 84 Anderson; 222, 223 Watson; Cooper; Palmer.

38. LUPINUS BREWERI. Gray, Proc. Amer. Acad., 6. 334. Watson, King's Rep., 5. 58. — No. 1634 Brewer; 20 Anderson; Gray.

53. LUPINUS BRIDGESII. Gray, MS. in herb. — No. 55 Bridges; 6512 Bolander; Kellogg.

10. LUPINUS BURKEI. — No. 46 Anderson; 36, 320 Stretch; 236 Watson; Burke; Hayden.

L. polyphyllus. Porter, Hayden's Rep., 1871, 480. Watson, King's Rep., 5. 55.

L. ——? Watson, King's Rep., 5. 58.

34. LUPINUS CÆSPITOSUS. Nuttall, Torr. & Gray's Flora, 1. 379. Dietrich, Syn., 4. 942. Gray, Proc. Acad. Phil., 1863, 59. Porter, Hayden's Rep., 1871, 480. — No. 253 Fremont; 96 Hall & Harb.; Nuttall; Parry.

29. LUPINUS CALCARATUS. Kellogg, Proc. Calif. Acad., 2. 195, **fig. 60.** Watson, King's Rep., 5. 56. — Nos. 30, 31, 92, 219 Anderson, and 233 in part; 266 Stretch; 1891 Brewer; 226 Watson; Beckwith; Bloomer.

L. decumbens, var. *argophyllus.* Torrey, Pac. R. R. Rep., 2. 121.

L. laxiflorus. Watson, King's Rep., 5. 55; not Dougl.

L. sulphureus. Watson, King's Rep., 5. 57; not Dougl.

49. LUPINUS CONCINNUS. Agardh, Syn. 6, **t. 1.** Hook. & Arn., Bot. Beech., 335. Torr. & Gray, Flora, 1. 372. Walpers, Repert., 1. 596. Dietrich, Syn., 4. 937. Torrey, Ives's Rep., 9. — No. 372 Coulter; Douglas; Smith; Hervey.

L. pusillus. Torrey, Bot. Mex. Bound., 57, in part.

Var. ARIZONICUS. — No. 287 a Schott; Fremont; Bigelow; Thomas; Palmer.

L. sparsiflorus. Torrey, Pac. R. R. Rep., 4. 81, in part; not Benth.

L. hirsutissimus. Torrey, Ives's Rep., 9; not Benth.

25. LUPINUS CONFERTUS. Kellogg, Proc. Calif. Acad., 2. 192, fig. 59. — Nos. 1691 Brewer; 6286 Bolander; 45 Anderson; 82, 89 Torrey; Kellogg & Harford.

L. Torreyi. Gray, MS. in herb. Watson, King's Rep., 5. 58.

L. sellulus. Kellogg, Proc. Calif. Acad. 5. 36.

52. LUPINUS DENSIFLORUS. Bentham, Hort. Trans., n. s., 1. 409. Lindl., Bot. Reg., t. 1689; (Lit. Ber. zu Linnæa, 1835, 56.) Torr. & Gray, Flora, 1. 371. Walpers, Repert., 1. 595. Dietrich, Syn., 4. 936 and 945. Torrey, Pac. R. R. Rep., 4. 81. Bolander, Cat., 8. — No. 381 Coulter; 147, 453, 473 Fremont; 59 Bridges; 959, 1039 Wilkes; 483 Brewer; 91 Torrey; 187 Kell. & Harf.; Bigelow; Peckham.

L. Menziesii. Agardh, Syn., 2. Hook. & Arn., Bot. Beech., 335. Torr. & Gray, Flora, 1. 371. Benth., Pl. Hartw., 303. Walpers, Repert., 1. 595. Hook., Bot. Mag., t. 5019. "Journ. d'Hort., 2, t. 3. Flor. des Serres, 14, t. 1458."

L. succulentus. Douglas; Koch in "Wochenschr. f. Gaertn., 4. 276"; Ind. Sem. h. Berl., 1867, Appx. 11.

L. Menziesii, var. *aurea.* Kellogg, Proc. Calif. Acad., 5. 16.

L. lacteus. Kellogg, Proc. Calif. Acad., 5. 37.

L. luteolus. Kellogg, Proc. Calif. Acad., 5. 38, mostly.

2. LUPINUS DIFFUSUS. Nuttall, Genera, 2. 93. Elliot, Sketch, 2. 192. DC. Prodr., 2. 410. Don's Mill., 2. 369. Chapman, Flora, 89.

L. villosus, var. *diffusus.* Torr. & Gray, Flora, 1. 382.

5. LUPINUS DOUGLASII. Agardh, Syn., 34. Hook. & Arn., Bot. Beech., 336. Torr. & Gray, Flora, 1. 380. Dietrich, Syn., 4. 943. Durand, Pl. Pratten., 86? — No. 384 Coulter; Douglas; Fremont; Wallace.

26. LUPINUS FLEXUOSUS. Lindley; Agardh, Syn., 34. Torr. & Gray, Flora, 1. 381. Dietrich, Syn., 4. 943. Cooper, Pac. R. R. Rep., 12. 59. — Douglas; Wilkes; Spalding.

50. LUPINUS GRACILIS. Agardh, Syn., 15, t. 1. Hook. & Arn., Bot. Beech., 335. Torr. & Gray, Flora, 1. 372. Walpers, Repert., 1. 598. Dietrich, Syn., 4. 936. — Douglas; Peckham; Willey.

48. LUPINUS HIRSUTISSIMUS. Bentham, Hort. Trans., n. s., 1. 409. Agardh, Syn., 4. Hook. & Arn., Bot. Beech., 335. Torr. & Gray, Flora, 1. 372. Walpers, Repert., 1. 595. Dietrich, Syn., 4. 936. Torrey, Pac. R. R. Rep., 7. 10; Bot. Mex. Bound., 57, in part; Bolander, Cat., 8. — No. 373 Coulter; 610 (or 510) Thurber; 316, 340 Brewer; Douglas; Bigelow.

L. sparsiflorus. Torrey, Pac. R. R. Rep., 4. 81, in part; not Benth.

32. LUPINUS HOLOSERICEUS. Nuttall; Torr. & Gray, Flora, 1. 380. Dietrich, Syn., 4. 943. — No. 232 Anderson; 88 Torrey; 229-232 Watson; 64 Eaton; Nuttall.

L. leucopsis. Watson, King's Rep., 5. 56.

L. flexuosus. Watson, l. c., 5. 55, in part; and var., l. c., 5. 56.

L. meionanthus, var. *heteranthus.* Watson, l. c., 5. 56.

Var. UTAHENSIS. — No. 232 Watson; 64 Eaton; Stansbury.

L. albicaulis. Torrey, Stansbury's Rep., 386; not Dougl. Durand, Fl. Utah, 163.

L. leucopsis, var. Watson, King's Rep., 5. 56.

36. Lupinus Kingii. — No. 234 Watson, in part.

L. aridus. Watson, King's Rep., 5. 57, in part.

30. Lupinus laxiflorus. Douglas; Lindl., Bot. Reg., 14, **t. 1140**. Hook., Fl. Bor. Am., 1. 164. Don's Mill., 2. 366. Agardh, Syn., 27. Torr. & Gray, Flora, 1. 377. Dietrich, Syn., 4. 941. Torrey, Pac. R. R. Rep., 2. 121? Cooper, Pac. R. R. Rep., 12. 59? Gray, Proc. Amer. Acad., 8. 379. — No. 106 Scouler; 423 Geyer; 227 Watson, and 228 in part; 90 Hall; Douglas; Fremont; Tolmie; Spalding; Kronkhite; Palmer; Wheeler.

L. arbustus. Douglas; Lindl., Bot. Reg., 15, **t. 1230**. Hook., Fl. Bor. Am., 1. 164. Don's Mill., 2. 368.

L. foliosus. Hook., Pl. Geyer, in Lond. Journ. Bot., 6. 215.

? *L. decumbens*. Torrey, Pac. R. R. Rep., 4. 81.

? *L. caudatus*. Kellogg, Proc. Calif. Acad., 2. 198, **fig. 61**.

L. argenteus. Watson, King's Rep., 5. 55; not Pursh.

L. flexuosus. Watson, l. c., 5. 55, in part.

24. Lupinus lepidus. Douglas; Lindl., Bot. Reg., 14, **t. 1149**. Hook., Fl. Bor. Am., 1. 163. Don's Mill., 2. 367. Agardh, Syn., 17. Lodd., Bot. Cab., **t. 1980**. Torr. & Gray, Flora, 1. 374. Dietrich, Syn., 4. 939. Newberry, Pac. R. R. Rep., 6. 71. Cooper, Pac. R. R. Rep., 12. 58. — No. 98 Douglas; 268 Stretch; 228 Watson, in part; Nuttall; Wilkes; Spalding; Newberry; Suckley; Bloomer.

L. concinnus. Durand, Pl. Pratten., 86; not Agardh.

L. flexuosus. Watson, King's Rep., 5. 55, in part.

43. Lupinus leptophyllus. Bentham, Hort. Trans., n. s., 1. 409. Lindl., Bot. Reg., 20, **t. 1670**. Agardh, Syn., 11. Torr. & Gray, Flora, 1 .373. Hook. & Arn., Bot. Beech., 335. Walpers, Repert., 1. 597. Dietrich, Syn., 4. 938. Torrey, Pac. R. R. Rep., 4. 81. Gray, Proc. Bost. Nat. Hist. Soc., 1860, 1. — No. 370 Coulter; 58 ("39") Bridges; 23 Xantus; Douglas; Heermann; Bigelow; Stillmann.

22. Lupinus leucophyllus. Douglas; Lindl., Bot. Reg., 13, **t. 1124**. Hook., Fl. Bor. Am., 1. 165. Don's Mill., 2. 367. Agardh, Syn., 31. Torr. & Gray, Flora, 1. 379. Torrey, Fremont's Rep., 89. Dietrich, Syn., 4. 942. Gray, Pl. Fendl., 38? Newberry, Pac. R. R. Rep., 6. 71. Cooper, Pac. R. R. Rep., 12. 52. Watson, King's Rep., 5. 57. Porter, Hayden's Rep., 1871, 480. Gray, Proc. Amer. Acad., 8. 379. — No. 737 Fremont; 390 Geyer, in part; 235 Watson; 67 Eaton; 87 Hall; 189 Kell. & Harf.; Douglas; Burke; Wilkes; Spalding; Lyall; Anderson.

L. plumosus. Douglas; Lindl., Bot. Reg., 15, **t. 1217**. Hook., Fl. Bor. Am., 1. 165. Don's Mill., 2. 367. Agardh, Syn., 32. Hook. & Arn., Bot. Beech., 336. Torr. & Gray, Flora, 1. 380. Dietrich, Syn., 4. 942.

L. albicaulis. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 216, in part.

11. Lupinus littoralis. Douglas; Lindl., Bot. Reg., 14, **t. 1198**. Graham, Edinb. Phil. Journ., 1829, 185. Hook., Bot. Mag., **t. 2952**; Fl. Bor. Am., 1. 164. Don's Mill., 2. 367. Agardh, Syn., 36. Hook. & Arn., Bot. Beech., 335. Torr. & Gray, Flora, 1. 381. Dietrich, Syn., 4. 943. Cooper, Pac. R. R. Rep., 12. 58. Boland., Cat. 8. — No. 393 Coulter; 65 Bridges; Douglas; Cooper.

L. Nutkatensis, var. *fruticosus*. Sims, Bot. Mag., t. 2136.

L. versicolor. Lindl., Bot. Reg., 23, t. 1979; not Sweet. Torr. & Gray, Flora, 1. 376. Dietrich, Syn., 4. 940.

L. Nutkatensis, var. *glaber*. Hook., Fl. Bor. Am., 1. 163.

L. Nutkatensis. Cooper, Pac. R. R. Rep., 12. 58; not Donn.

39. Lupinus Lyallii. Gray, Proc. Amer. Acad., 6. 334. — Lyall.

Var. Danaus. — No. 5087 Bolander.

L. Danaus. Gray, Proc. Amer. Acad., 6. 335.

33 Lupinus meionanthus. Gray, Proc. Amer. Acad., 6. 522. Watson, King's Rep, 5. 56. — Nos. 2, 125 Anderson.

42. Lupinus micranthus. Dougl., Lindl. Bot. Reg., 15, t. 1251. Hook., Fl. Bor. Am., 1. 162. Don's Mill., 2. 366. Agh., Syn., 14. Torr. & Gray, Flora, 1. 373. Hook. & Arn., Bot. Beech., 335. Walpers, Repert., 2. 598. Dietr., Syn., 4. 938. Newberry, Pac. R. R. Rep., 6. 70. Cooper, Pac. R. R. Rep., 12. 58. Torrey, Bot. Mex. Bound., 57. Boland., Cat. 8. — No. 78 Fremont; 481, 601, 602 Thurber; 868, 982, 1149 Brewer; 84 Torrey; 180 Kell. & Harf., in part; 84 Hall; Douglas; Nuttall; Coulter; Wilkes; Parry; Wallace; Peckham.

L. nanus, var. Benth., Pl. Hartw., 303.

L. bicolor. Torrey, Bot. Mex. Bound., 57. Gray, Proc. Amer. Acad., 8. 379.

Var. bicolor. — No. 398 Coulter; 1691 Hartweg; 56 Bridges; 242 Fremont; 180 Kell. & Harf., in part; Douglas.

L. bicolor. Lindl., Bot. Reg., 13, t. 1109. Hook., Fl. Bor. Am., 1. 162. Don's Mill., 2. 366. Agardh, Syn., 14. Torr. & Gray, Flora, 1. 373. Hook. & Arn., Bot. Beech., 335. Walp. Rep., 2. 598. Dietr. Syn., 4.938. Torrey, Pac. R. R. Rep., 4. 81, in part. Newberry, Pac. R. R. Rep., 6.70.

L. gracilis. Durand & Hilgard, Pac. R. R. Rep., 5. 7, in part.

Var. microphyllus. — Nuttall; Heermann; Fitch.

L. microphyllus. Nutt., MS. in herb.

Var. trifidus. — No. 183 Kell. & Harf., in part; Bigelow; Fitch; Shelton.

L. bicolor. Torrey, Pac. R. R. Rep., 4. 81, in part.

L. trifidus. Torrey, MS. in herb.

51. Lupinus microcarpus. Sims, Bot. Mag., t. 2413. DC. Prodr., 2. 408. Don's Mill., 2. 366. Agardh, Syn., 2. Hook. & Arn., Bot. Beech. 21 and 335. Torr. & Gray, Flora, 1. 371. Walpers, Repert., 1. 595. Dietrich, Syn., 4. 936. Gray, Proc. Bost. Nat. Hist. Soc., 1860, 1. — No. 1692 Hartweg; 60 Bridges; 579 Thurber; 21 Xantus; 959, 1039 Wilkes, in part; 100 Bolander; 185 Kell. & Harf.; Brewer; Peckham.

L. densiflorus. Agardh, Syn., 3; not Benth., in Hort. Trans. Benth., Pl. Hartw., 303. Hook. & Arn., Bot. Beech., 335.

L. palustris. Kellogg, Proc. Calif. Acad., 5. 16.

L. Menziesii. Torrey, Bot. Mex. Bound., 57.

37. Lupinus minimus. Douglas; Hook., Fl. Bor. Am., 1. 163. Agardh, Syn., 16. Don's Mill., 2. 367, and 476. Torr. & Gray, Flora, 1. 374. Dietrich, Syn., 4. 939. Gray, Proc. Amer. Acad., 6. 335; 8. 379. — No. 1065 Wilkes; 92 Hall; Douglas; Lyall.

41. LUPINUS NANUS. Douglas; Bentham, Hort. Trans., n. s., 1. 409, **t. 14.** Don, Sweet's Brit. Fl. Gard., 2 ser., **t. 257.** Agardh, Syn., 11. Lindl., Bot. Reg., 20 **t. 1705.** Hook. & Arn., Bot. Beech., 335. Torr. & Gray, Flora, 1. 373. Walpers, Repert., 1. 597. Dietrich, Syn., 4. 938. Benth., Pl. Hartw., 303. Durand, Pl. Pratten., 86. Torrey, Pac. R. R. Rep., 4. 81. Newberry, Pac. R. R. Rep., 6. 70. Bolander, Cat., 8. — Nos. 386, 388 Coulter; 1690 Hartweg; 57, 57a, 58b, 66 Bridges; 22 Xantus; 379, 451 Brewer; 87 Torrey; 181 Kell. & Harf., and 183 in part; Douglas; Nuttall; Newberry; Bigelow; Gibbons; Fitch.

L. affinis. Agardh, Syn., 20, in part. Torrey, Bot. Mex. Bound., 57, in part.

L. nanus, var. *latifolius.* Benth., Pl. Hartw., 303. Torrey, Pac. R. R. Rep., 4. 81.

L. sparsiflorus. Torrey, Pac. R. R. Rep., 5. 360. Gray, Ives's Rep., 9.

L. bicolor. Gray, Proc. Bost. Nat. Hist. Soc., **7. 146.**

6. LUPINUS NOOTKATENSIS. Donn, "Cat. Cant." Sims, Bot. Mag., **t. 1311.** Aiton, Hort. Kew., 2 ed., 4. 286. Pursh, Flora, 467. Lodd., Bot. Cab., **t. 879.** DC. Prodr., 2. 408. Hook., Fl. Bor. Am., 1. 163, excl. var. Agardh, Syn., 21. Don's Mill., 2. 366. Hook. & Arn., Bot. Beech., 335. Torr. & Gray, Flora, 1. 375. Ledeb., Fl. Ross., 1. 512. Dietrich, Syn., 4. 940. Regel, "Ind. Sem. h. Petr. 1857"; Müller, Annal., 7. 674. Rothrock, Fl. Alaska, 445. — Eschscholtz; Burke; Harrington; Elliot.

L. variegatus. Poiret, Suppl., 3. 520.

L. Nutkanus. Sprengel, Syst., 3. 227.

L. macrorrhizos. Georgi, "Beschr. Ross., 4. 1162."

L. Blaschkeanus. Fisch. & Mey., Ind. Sem. h. Petr., 1846, Suppl., 57.

Var. UNALASKENSIS. — Eschscholtz; Rudolphi; Barclay; Harrington.

L. Regius. Rudolphi.

13. LUPINUS NUTTALLII.

L. gracilis. Nuttall, Journ. Phil. Acad., 7. 115; not Agardh.

L. perennis, var. Torr. & Gray, Flora, 1. 376. Chapman, Flora, 89.

19. LUPINUS ORNATUS. Douglas; Lindl., Bot. Reg., 14. **t. 1216.** Hook., Fl. Bor. Am., 1. 164. Don's Mill., 2. 367. Sweet, Brit. Fl. Gard., 2 ser., **t. 212.** Agardh, Syn., 28. Torr. & Gray, Flora, 1. 378. Dietrich, Syn., 4. 942. Torrey, Pac. R. R. Rep.. 7. 10; Bot. Mex. Bound., 57. Boland., Cat., 8. Gray, Proc. Amer. Acad., 8. 379. — Nos. 1387, 2180 Brewer; 88 Hall; Douglas; Wilkes; Bigelow; Parry; Stillman; Sprague; Howard; Gray.

L. leucopsis. Agardh, Syn., 29. Torr. & Gray, Flora, 1. 378. Dietr., Syn., 4. 942.

L. argenteus. Agardh, Syn., 27; not Pursh. Torr. & Gray, Flora, 1. 377, in part. Dietrich, Syn., 4. 942.

L. rivularis. Torrey, Pac. R. R. Rep., 4. 81; not Dougl.

L. sericeus. Cooper, Pac. R. R. Rep., 12. 52; not Pursh.

L. Douglasii. Torrey, Bot. Mex. Bound., 57; not Agardh.

Var. GLABRATUS. — No. 578 Fremont; 95 Hall & Harb.; 104 Vasey; Gordon; Greene.

L. ornatus. Torrey, Fremont's Rep., 89, in part. Gray, Proc. Phil. Acad., 1863, 59. Engelm., Pl. Upp. Miss., 190. Porter, Hayden's Rep., 1870, 474; 1871, 480.

23. LUPINUS PALMERI. — Palmer.

28. LUPINUS PARVIFLORUS. Nuttall; Hook. & Arn., Bot. Beech., 336. Torr. & Gray, Flora, 1. 375. Dietrich, Syn., 4. 939. Porter, Hayden's Rep., 1870, 474. Watson, King's Rep., 5. 54. Gray, Proc. Amer. Acad., 8. 379. — No. 413 Fremont; 225 Watson; 65 Eaton; 91 Hall; Nuttall; Tolmie; Gray.

12. LUPINUS PERENNIS. Linn., Spec., 721. Desrous., Lam. Dict., 3. 621; Ill., t. 616. Aiton, Hort. Kew., 2.28. Sims, Bot. Mag., t. 202. Michaux, Flora, 2. 55. Persoon, 2. 293. Pursh, Flora, 467. Barton, "Flora, 2. t. 38." Elliott, Sketch, 2. 19. DC. Prodr., 2. 408. Hook., Fl. Bor. Am., 1. 163, in part. Darlington, Fl. Cestr., 431. Torr. & Gray, Flora, 1. 376, in part. Parry, Cat. Pl. Wisc., 611. Engelm., Pl. Upp. Miss., 190. Cooper, Pac. R. R. Rep., 12. 42. Chapman, Flora, 89. Gray, Manual, 126.

7. LUPINUS POLYPHYLLUS. Lindl., Bot. Reg., 13. t. 1096, and 16. t. 1377. Hook., Fl. Bor. Am., 1. 164. Agardh, Syn., 17. Don's Mill., 2. 366. Hook. & Arn., Bot. Beech., 138. Torr. & Gray, Flora, 1. 375. Dietrich, Syn., 4. 939. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 216. "Reichenb., Exot., t. 176." Newberry, Pac. R. R. Rep., 6. 70. Cooper, Pac. R. R. Rep., 12. 58. Regel, Ind. Sem. h. Petr., 1866, 108. Bolander, Cat., 8. Gray, Proc. Amer. Acad., 8. 379. — No. 105 Scouler; 6507 Bolander; 85 Hall; Nuttall; Lyall; Shelton; Cronkhite; Williamson.

L. grandiflorus. Lindl.; Agardh, Syn., 18. Hook. & Arn., Bot. Beech., 335.

L. macrophyllus. Bentham; Don, Sweet's Brit. Fl. Gard., 2. ser., t. 356, and Addenda.

54. LUPINUS PUSILLUS. Pursh, Flora, 468. Nuttall, Gen., 2. 93. DC. Prodr., 2. 408. Torrey, Ann. N. Y. Lyc., 2. 191. Hook., Fl. Bor. Am., 1. 162. Agardh, Syn., 15. Torr. & Gray, Flora, 1. 374. Torrey, Nicollet's Rep., 149. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 216. Gray, Pl. Wright., 2. 49; Pl. Thurb., 300; Ives's Rep., 9. Torrey, Sitgreave's Rep., 158; Bot. Mex. Bound., 57, in part. Cooper, Pac. R. R. Rep., 12. 42. Engelm., Pl. Upp. Miss., 190. Gray, Proc. Phil. Acad., 1863, 59. Porter, Hayden's Rep., 1870, 474; 1871, 480. Watson, King's Rep., 5. 53. — No. 161 Nicollet; 103, 296 Fremont; 959, 1039 Wilkes, in part; 31, 287 Parry; 94 Hall & Harb.; 221 Watson; 103 Vasey; 103 Greene; 88 Culbertson; James; Nuttall; Burke; Woodhouse; Newberry; Stevens; Engelmann; Anderson.

9. LUPINUS RIVULARIS. Douglas; Lindl., Bot. Reg, 19. t. 1595; (Litt. Ber. zu Linnæa, 1835, 16.) — No. 383 Coulter; 62 Bridges; 14 Gibbons; 83, 83 a Torrey; 86 Hall; 186, 188 Kell. & Harf.; Douglas; Bigelow; Parry; Samuels.

L. lucidus. Hort. Soc.

L. latifolius? Gray, Proc. Amer. Acad., 8. 379.

Var. LATIFOLIUS. — No. 622 Thurber; 284, 392, 637, 869, 996 Brewer; Douglas; Bigelow.

L. latifolius. Agardh, Syn., 18. Lindl., Bot. Reg., 22. t. 1891. Torr. & Gray, Flora, 1. 375. Hook. & Arn., Bot. Beech., 335. Dietrich, Syn.,

4. 939. Durand, Pl. Pratten., 86? Torrey, Pac. R. R. Rep., 4. 81. Newberry, Pac. R. R. Rep., 6. 70? Bolander, Cat., 8.

L. cytisoides. Torrey, Bot. Mex. Bound., 57, in part.

15. Lupinus Sabinii. Douglas; Hook., Fl. Bor. Am., 1. 166. Torr. & Gray Flora, 1. 378. Dietrich, Syn., 4. 942. — Douglas; Bigelow?

L. Sabinianus. Douglas; Lindl., Bot. Reg., 17. **t. 1435.** Don's Mill., 2. 367. Agardh, Syn., 30.

? *L. macrocarpus.* Torrey, Pac. R. R. Rep., 4. 81.

21. Lupinus sericeus. Pursh, Flora, 468. DC. Prodr., 2. 408. Hook., Fl. Bor. Am., 1. 164. Don's Mill., 2. 367. Agardh, Syn., 31. Torr. & Gray, Flora, 1. 379, in part. Hook. & Arn., Bot. Beech., 336. Benth., Bot. Sulph., 11. Dietrich, Syn., 4. 942. Watson, King's Rep., 5. 57. — No. 390 Geyer, in part; 233 Watson, and 228, in part; 66 Eaton; Wyeth; Beckwith; Mullan.

L. ornatus. Nuttall, Proc. Phil. Acad., 1822, 7.

L. affinis. Torr. & Gray, Pac. R. R. Rep., 2. 121.

L. albicaulis. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 216, in part.

L. flexuosus. Watson, King's Rep., 5. 55, in part.

17. Lupinus Sitgreavii. — Sitgreave; 2012 Brewer; 1020 Wright; Wheeler.

L. Mexicanus. Torr., Bot. Mex. Bound., 57. Gray, Pl. Wright., 2. 49, in part.

? *L. Mexicanus.* Gray, Pl. Wright., 2. 49, in part.

44. Lupinus sparsiflorus. Bentham, Pl. Hartw., 303. Walpers, Annal., 2. 319. Torrey, Bot. Mex. Bound., 57. — No. 595 Thurber; Coulter; Heermann; Wallace; Peckham.

L. gracilis. Dur. & Hilg., Pac. R. R. Rep., 5. 7, in part.

47. Lupinus Stiveri. Kellogg, Proc. Calif. Acad., 2. 192, **fig. 58.** — Nos. 45, 55 a Bridges; 90 Torrey; Stillman; Bolander; Goodale; Kellogg; Gray; Dix.

46. Lupinus subcarnosus. Hook., Bot. Mag., **t. 3467.** Torr. & Gray, Flora, 1. 372. Walpers, Repert., 1. 596. Dietrich, Syn., 4. 937. Scheele, Roemer's Texas, 428. Gray, Pl. Wright., 1. 54. Torrey, Bot. Mex. Bound., 57.

L. bimaculatus. Hooker; Don, Sweet's Brit. Fl. Gard., 2 ser., **t. 314**; not Lam. Walpers, Repert., 1. 596.

L. Texensis. Hook., Bot. Mag., **t. 3492.** Torr. & Gray, Flora, 1. 372. Walpers, Repert., 1. 596. Dietrich, Syn., 4. 937. Gray, Pl. Lindh., 34 and 177. Scheele, Roemer's Texas, 428.

20. Lupinus sulphureus. Douglas; Hook., Fl. Bor. Am., 1. 166. Don's Mill., 2. 367. Agardh, Syn., 30. Torr. & Gray, Flora, 1. 378. Dietrich, Syn., 4. 942. — Douglas; Spalding?; Wyeth?

? *L. sericeus.* Torr. & Gray, Flora, 1. 379, in part.

45. Lupinus truncatus. Nuttall; Hook. & Arn., Bot. Beech., 336. Torr. & Gray, Flora, 1. 373. Walpers, Repert., 1. 597. Dietrich, Syn., 4. 938. Torrey, Bot. Mex. Bound., 57. Bolander, Cat., 8. — Nos. 369, 378, 397 Coulter; 539 Thurber: 345, 385 Brewer; Douglas; Nuttall; Wallace; Parry.

56. Lupinus uncialis. Watson, King's Rep., 5. 54, **t. 7.** — No. 224 Watson.

1. Lupinus villosus. Willd., Spec., 3. 1029. Persoon, Ench., 2. 294. Aiton,

Hort. Kew., 2 ed., 4. 287. Poir., Suppl., 3. 519. Pursh, Flora, 468, **t. 21.** Nuttall, Gen., 2. 93. Elliott, Sketch, 2. 191. DC. Prodr., 2. 410. Agardh, Syn., 41. Torr. & Gray, Flora, 1. 382. Chapman, Flora, 89.

L. pilosus. Walter, Fl. Car., 180; not Linn. Michaux, Flora, 2. 56.

L. integrifolius. Desrous., Lam. Dict., 3. 627; not Linn.

8. Lupinus Wyethii. — Wyeth; Spalding.

L. sericeus. Nuttall, Journ. Acad. Phil., 7. 79; not Pursh.

Cross-References.

L. affinis; L. nanus; L. sericeus.

L. albicaulis; L. holosericeus, var.; L. leucophyllus; L. sericeus.

L. argenteus; L. laxiflorus; L. ornatus.

L. arbustus = L. laxiflorus.

L. aridus; L. Kingii.

L. bicolor; L. micranthus; L. nanus.

L. bimaculatus = L. subcarnosus.

L. Blaschkeanus = L. Nootkatensis.

L. caudatus = L. laxiflorus.

L. cervinus = L. affinis.

L. Chamissonis = L. albifrons.

L. concinnus; L. lepidus.

L. cytisoides = L. rivularis.

L. Danaus = L. Lyallii, var.

L. decumbens; L. argenteus; L. calcaratus; L. laxiflorus.

L. densiflorus = L. microcarpus.

L. Douglasii = L. ornatus.

L. flexuosus; L. holosericeus; L. laxiflorus; L. lepidus; L. sericeus.

L. foliosus; L. albicaulis; L. laxiflorus.

L. gracilis; L micranthus; L. sparsiflorus; L. Nuttallii.

L. grandifolius = L. polyphyllus.

L. hirsutissimus; L. concinnus.

L. holosericeus; L. albifrons.

L. lacteus = L. densiflorus.

L. integrifolius = L. villosus.

L. latifolius = L. rivularis.

L. laxiflorus; L. albicaulis; L. argenteus; L. calcaratus.

L. leucopsis; L. holosericeus; L. ornatus.

L. littoralis; L. albifrons.

L. luteolus = L. densiflorus?

L. lucidus = L. rivularis.

L. macrocarpus; L. arboreus; L. Sabinii.

L. macrophyllus = L. polyphyllus.

L. macrorrhizos = L. Nootkatensis.

L. meionanthus; L. holosericeus.

L. Mexicanus; L. albicaulis; L. Sitgreavii.

L. Menziesii; L. densiflorus; L. microcarpus.

L. microphyllus = L. micranthus.

L. nanus; L. micranthus.

L. Nootkatensis; L. littoralis.

L. ornatus; L. albifrons; L. argenteus; L. sericeus.

L. palustris = L. microcarpus.

L. perennis; L. arcticus; L. Nuttallii.

L. pilosus = L. villosus.

L. plumosus = L. leucophyllus.

L. polyphyllus; L. Burkei.

L. pusillus; L. concinnus.

L. regius = L. Nootkatensis.

L. rivularis; L. arboreus; L. ornatus.

L. sellulus = L. confertus.

L. sericeus; L. albifrons; L. arboreus; L. ornatus; L. sulphureus; L. Wyethii.

L. sparsiflorus; L. concinnus; L. hirsutissimus; L. nanus.

L. succulentus = L. densiflorus.

L. sulphureus; L. calcaratus.

L. tenellus = L. argenteus.

L. Texensis = L. subcarnosus.

L. trifidus = L. micranthus, var.

L. variegatus = L. Nootkatensis.

L. versicolor = L. littoralis.

L. villosus; L. diffusus.

Revision of the extra-tropical North American Species of the Genus Potentilla (excluding Sibbaldia, Horkelia, *and* Ivesia*).* — By Sereno Watson.

The materials for this and the following revisions were the same as for the last, namely, the collections belonging to Harvard and Columbia Colleges, to the Philadelphia Academy, and to Professor Eaton. The number of species has been considerably reduced, owing to a better knowledge of some of the obscurer species, and especially to the less weight which has been given to the distinction between pinnate and digitate leaves and the number of leaflets, to differences in the amount of pubescence, and in some species to the number of stamens.

The genera *Sibbaldia*, *Horkelia*, and *Ivesia*, distinguished by minor but apparently sufficient characters, are not included. The synonymy, etc., of the common eastern species is limited mainly to references respecting their more western or northern range.

Synopsis of Species.

I. Styles fusiform; carpels numerous, glabrous; inflorescence terminal.

* Style attached near the base of the ovary; disk thickened; stamens 25 – 30; perennial herbs with glandular-villous pubescence, pinnate leaves, and rather large white or yellow flowers.

Stout; cyme strict and rather close; leaflets 7 – 11; stamens mostly 30 . . . . 1. *P. arguta.*

Slender; cyme loosely panicled; leaflets 5 – 9; stamens mostly 25 . . . . 2. *P. glandulosa.*

* * Style terminal; disk not thickened; flowers small, yellow; leaves pinnate or ternate.

† Annual or biennial; leaflets incisely serrate, not white-tomentose; stamens 5 – 20

Stout, erect, hirsute; cyme rather close, leafy; leaves ternate; calyx large; stamens 15, rarely 20 . . 3. *P. Norvegica.*

More slender and branched, softly villous; cyme loose, often diffuse, less leafy; leaflets pinnately 5 or 3; calyx small; petals minute; stamens 10 – 20 (rarely 5) . . . . 4. *P. rivalis.*

Subdecumbent, subvillous; cyme loose, leafy; leaflets pinnately 5 – 11; stamens 20; achenia strongly gibbous on the ventral side . . . . . 5. *P. supina.*

† † Herbaceous perennials, more or less white-tomentose; leaflets incisely pinnatifid; bractlets and sepals nearly equal; stamens 20 – 25.

Leaflets 5 – 9; cyme fastigiate; stamens 25, sometimes 20 . . . . 6. *P. Pennsylvanica.*

Leaflets 3; cyme close; stamens 20; low . . 7. *P. Hookeriana.*

Leaflets 3 – 5; flowers 1 – 3, on slender pedicels; stamens 20; low, arctic . . . . . . 8. *P. pulchella.*

II. Styles filiform; inflorescence terminal.

* Style terminal (nearly so in *P. brevifolia*); carpels glabrous; disk not thickened; stamens 20; herbaceous perennials, with rather large yellow flowers.

† Leaves pinnate (sometimes digitate in Nos. 9 and 14); carpels 10 – 40; bractlets shorter than the sepals.

Leaflets 5 – 11, white-tomentose, at least beneath, diminishing uniformly down the petiole; carpels 10 – 30 . . . . 9. *P. Hippiana.*

Leaflets 5 – 11, white-tomentose, the alternate ones smaller; carpels 10 . . . . 10. *P. effusa.*

Appressed silky-villous; stems decumbent; leaflets 9 – 15, folded, falcate; carpels 25 – 30 . . . 11. *P. crinita.*

Low, alpine or subalpine; flowers few.

White-tomentose; leaflets 7 – 13, broadly cuneate; flowers rather large in a close cyme . . . 12. *P. Breweri.*

Silky-villous or subglabrous; leaflets 7 – 13, small, broadly cuneate; flowers small, in an open cyme . 13. *P. Plattensis.*

Subglabrous or silky-villous; leaflets 5 – 7, rarely 3, often digitate . . . . 14. *P. dissecta.*

† † Leaves digitately 5 – 7-foliolate (rarely pinnate in *P. gracilis*); tomentose or villous.

Leaflets 5 – 7, rarely 3; bractlets shorter than the sepals; carpels more than 40; Western . . 15. *P. gracilis.*

Leaflets 5, white-tomentose beneath, smooth above; bractlets and sepals equal; carpels more than 40; Eastern . . . . 16. *P. argentea.*

Leaflets 5, toothed only at the apex, tomentose and villous; stems decumbent; carpels 15 – 20 . 17. *P. humifusa.*

† † † Leaves ternate (quinate in *P. maculata*); low, arctic or alpine, few-flowered; carpels 15 – 40.

Tomentose and villous; bractlets acute . . 18. *P. nivea.*

Villous or densely tomentose; bractlets obtuse; Alaska . . . . 19. *P. fragiformis.*

Sparingly villous or subglabrous.

Leaflets 5, rarely 3; bractlets shorter than the sepals; Labrador and Greenland . . . 20. *P. maculata.*

Flowers mostly solitary; bractlets and sepals equal, obtuse . . . . 21. *P. emarginata.*

Nearly glabrous; flowers 1 – 3; bractlets and sepals nearly equal; Oregon . . . . 22. *P. gelida.*

Flowers 3 – 6; bractlets much shorter; Western . . . 23. *P. Grayi.*

Flowers solitary; bractlets and sepals equal, obtuse; very dwarf, villous; White Mts. . . 24. *P. frigida.*

Leaflets roundish, 2 – 3-lobed and crenate; glandular-puberulent; Rocky Mts. . . . . 25. *P. brevifolia.*

* * Style terminal or medial; carpels glabrous; disk thickened or glandular; stamens 20; smooth or smoothish herbaceous perennials, with large purple or yellow flowers.

Style attached to the middle of the ovary; flowers purple; leaves pinnately 5 – 7-foliolate . . 26. *P. palustris.*

Style terminal; flowers purple; leaves digitately 5 - 7-foliolate; New Mexico . . . . . 27. *P. Thurberi.*

Style attached below the apex; flowers yellow; leaflets 3, 2 – 3-parted; arctic, dwarf . . . . . 28. *P. biflora.*

* * * Style attached below the middle; carpels and receptacle densely villous; woody perennials.

Shrubby, erect, much branched; leaves pinnate; leaflets 5 – 7, entire . . . . 29. *P. fruticosa.*

Woody only at base, low; leaflets 3, toothed at the apex; flowers white . . . . 30. *P. tridentata.*

III. Styles filiform; peduncles axillary, solitary, 1-flowered; carpels glabrous; stems creeping or decumbent; herbaceous perennials.

Style attached to the middle of the ovary; leaves pinnately 7 – 21-foliolate . . . . 31. *P. Anserina.*

Style attached below the apex; leaves apparently quinate . . . . 32. *P. Canadensis.*

Style attached below the apex; leaves ternate or quinate; sepals and petals usually 4 . . . . . . 33. *P. nemoralis.*

I. Styles thickened and glandular toward the base; carpels glabrous, numerous, sessile; inflorescence cymose. — Spec. 1 – 8.

* Style attached below the middle of the ovary; disk thickened and pentagonal; stamens 25 – 30, rarely twenty, in one row on the margin of the disk; herbaceous perennials, with pinnate leaves; pubescence glandular-villous.

1. P. ARGUTA, Pursh. Stems erect, usually stout, 1 – 4° high, simple below; pubescence spreading; stipules ovate, acute, entire or incised; radical leaves 7 – 11-foliolate, 4–12′ long, usually long-petioled; leaflets rounded, ovate, or subrhomboidal, incised or doubly serrate, smoother on the upper surface, the terminal one 1 – 3′ long; cyme usually crowded, with strict pedicels becoming rigid; calyx densely pubescent, the acute sepals 3 – 4″ (becoming 5″) long, bractlets much

smaller; petals suborbicular, 3 – 4″ long, white, yellowish, or in some western specimens bright yellow; stamens mostly 30, with dark thickened anthers. — From New England to the Saskatchewan, and in the Rocky Mts. from Northern Idaho to New Mexico.

2. P. GLANDULOSA, Lindl. (*P. fissa*, Nutt.; *P. Wrangeliana*, Fisch. & Mey.) Resembling the last, but usually more slender and branched, 1 – 2° high, and for the most part less pubescent; leaflets more frequently 5 – 9, usually 1′ long or less; cyme panicled, with elongated branches and more slender pedicels; flowers often smaller; calyx much less tomentose, becoming less rigid; bractlets linear; petals yellow, sometimes white; stamens usually 25. — Washington Territory to California, and eastward to the mountains of Colorado and New Mexico. A very slender form with but few small flowers and sometimes but 20 stamens, the cyme often close, is found in the Sierra Nevada and in Colorado.

* * Style terminal; disk not thickened; flowers small, yellow; leaves pinnate or ternate.

† Annual or biennial; leaflets incisely serrate, not white-tomentose; stamens 5 – 20.

3. P. NORVEGICA, L. Erect, stout, ½ – 2° high, leafy, at length dichotomous above, hirsute; stipules large, ovate, coarsely incised or entire; leaves ternate, mostly short-petioled; leaflets obovate or oblong-lanceolate, 1 – 3′ long; cyme leafy and rather loose; calyx large, becoming 3 – 5″ long, the bractlets nearly equalling or exceeding the sepals; petals shorter, obovate, emarginate; stamens 15, in two rows, rarely 20; achenia rugose or nearly smooth; receptacle large, oblong. — From Labrador and the Northern States to Washington Territory, Alaska, and Pt. Barrow, and in the Rocky Mts. southward to New Mexico; sparingly introduced in the Southern States. *P. Labradorica*, Lehm., is but an unusually smooth form.

4. P. RIVALIS, Nutt. More slender, usually diffusely branched, even from the base; pubescence softly villous, spreading, sometimes nearly wanting; stipules lanceolate to ovate, entire or toothed; leaves pinnate, with two pairs of closely approximate leaflets, or a single pair and the terminal leaflet 3-parted, the upper leaves ternate; leaflets ovate or oblong-cuneate or lanceolate, 1 – 1½′ long, more or less incised-serrate; cymes loose, less leafy, with slender pedicels; bractlets and sepals equal, 1½ – 3″ long; petals minute; stamens 10 – 20; achenia

usually smooth; receptacle short. — From the Missouri River to New Mexico, and westward to Southern California and the valley of the Columbia. A rather variable species. The stamens opposite to the petals and to the midvein of the sepals are often wanting wholly or in part. The ovules are amphitropous or nearly orthotropous.

Var. MILLEGRANA. (*P. millegrana*, Engelm.) Leaves all ternate; stems erect, or weak and ascending; achenia often small and light-colored.

Var. PENTANDRA. (*P. pentandra*, Engelm.) Leaves ternate, the lateral leaflets of the lower leaves parted nearly to the base; stamens 5, opposite to the sepals. — Dr. Engelmann collected specimens of this in 1835 near Ft. Gibson, Arkansas. It has not been found since, and seems to be but a form of *P. rivalis*, the usual outer circle of 10 stamens (in pairs opposite to the sepals) being suppressed.

5. P. SUPINA, L. (*P. paradoxa*, Nutt.) Stems decumbent at base or erect, often stout, leafy, the rootstock apparently sometimes perennial; pubescence scanty, villous, spreading; stipules ovate, mostly entire; leaflets 5 – 11, obovate or oblong, ½ – ¾′ long; cymes loose, leafy; bractlets and sepals nearly equal; petals obovate, 2″ long, equalling the calyx; stamens 20; receptacle thick; achenia strongly gibbous by the thickening of the very short pedicel. — From the Lakes to the Saskatchewan and "Oregon" (Nuttall), and southward from the Missouri to New Mexico. The gibbosity of the achenium, scarcely observable in the European form, and the only distinguishing mark of *P. paradoxa*, is found fully as decided in specimens from Siberia, China, and the Himalaya.

Var. NICOLLETII. Slender and seemingly decumbent; leaflets mostly but three; inflorescence much elongated, leafy, and falsely racemose. — Collected by Nicollet at Devil's Lake, Minnesota.

† † Herbaceous perennials, more or less white-tomentose; leaflets incisely pinnatifid; bractlets and sepals nearly equal; stamens 20 – 25.

6. P. PENNSYLVANICA, L. Silky-tomentose; stems erect or decumbent at base, ½ – 2° high; stipules incised; leaflets 5 – 9, white-tomentose beneath, short-pubescent and greener above, oblong, obtuse, often approximate, the linear segments obtuse or acute, slightly or not at all revolute; cyme fastigiate but rather open, the pedicels erect; bractlets as long as the sepals or longer, sometimes a little shorter, obtuse or

acute; petals suborbicular, emarginate, 2″ long, about equalling the calyx; stamens usually 25; carpels numerous. — With scarcely a doubt to be referred to *P. sericea.* The species are kept distinct by all Russian botanists, though Regel & Herder state that the only apparent distinction is in the larger flowers of *P. sericea*, and that this is probably but the large-flowered alpine form of *P. Pennsylvanica.* — Found on the coast of Maine and New Hampshire, and in British America from Canada to the Rocky Mts., and rather common southward in the mountains to Colorado and New Mexico. It is occasionally somewhat resinous, especially upon the calyx, and sometimes the achenia.

Var. STRIGOSA, Lehm. Stems 6 – 12′ high; silky-tomentose throughout, the upper surface of the leaves scarcely less so; leaflets deeply pinnatifid, margins of the narrow lobes revolute; cyme short and close. — From Wisconsin and the Saskatchewan to Kansas, and in the mountains to New Mexico. The var. *bipinnatifida*, Torr. & Gray, is merely a form with the elongated linear segments usually more spreading.

Var. GLABRATA. (*P. sericea*, var. *glabrata*, Lehm.) "Leaves subglabrous on both sides, the lobes of the leaflets silky-tufted at the apex." — Rocky Mts. of British America (Drummond).

7. P. HOOKERIANA, Lehm. Densely white-tomentose and villous, the leaves greener above; stems 3 – 5′ high; leaflets three, cuneate-ovate, 5 – 8″ long, incised nearly to the midvein, the middle one shortly petiolulate; flowers short-pedicelled, in dense cymelets on the slender branches; calyx very silky-villous, the narrow bractlets equalling the acute sepals; petals obcordate, 1½ – 2″ long, equalling or exceeding the calyx; stamens 20. — British America. Specimens collected by Bourgeau on the Saskatchewan accord with Lehmann's description and figure.

8. P. PULCHELLA, R. Br. Dwarf, arctic, silky-villous and tomentose; stems 1 – 4′ high, 1 – 3-flowered, slender, naked; leaves pinnately 3 – 5 foliolate, the ovate leaflets 3 – 6″ long, coarsely cleft nearly to the midvein, the linear-oblong lobes divaricate; bractlets broad, equalling the sepals; petals obovate or obcordate, 2″ long, equalling the calyx; stamens 20. — Arctic America and Greenland (Parry; Kane; Hayes).

II. Styles filiform, not glandular at base; inflorescence cymose. — Spec. 9 – 29.

* Style terminal (or nearly so in *P. brevifolia*); carpels glabrous,

mostly sessile; disk not thickened; stamens 20, rarely 25; herbaceous perennials with conspicuous yellow flowers.

† Leaves pinnate (or sometimes digitate in *P. Hippiana* and *diversifolia*); carpels usually 10 – 30; bractlets shorter than the sepals.

9. P. HIPPIANA, Lehm. Densely white-tomentose and silky throughout, the upper surface of the leaves a little darker; stems ascending, 1 – 1½° high, slender, branching above into a diffuse cyme; stipules usually entire; leaves occasionally digitate, especially in reduced alpine specimens; leaflets 5 – 11, cuneate-oblong, 1 – 2′ long, obtuse, incisely toothed at least toward the apex, margin not revolute; pedicels slender; bractlets narrow; petals 2½ – 3½″ long, exceeding the calyx. — From the Saskatchewan to Nebraska, Colorado, New Mexico, and Northern Arizona.

Var. PULCHERRIMA. (*P. pulcherrima*, Lehm. *P. diffusa*, Gray. *P. Pennsylvanica*, var. *pulcherrima*, Torr. & Gray.) Stems 1 – 2° high; leaflets 5 – 9, approximate, crowded, or digitate, the terminal one 1 – 3′ long, the upper surface green and pubescent or subglabrous. — From the Rocky Mts. of British America to New Mexico and Northern Nevada; Ft. Vancouver (Alvord).

10. P. EFFUSA, Dougl. Tomentose throughout, with scattered villous hairs; stems ascending, 4 – 12′ high, diffusely branched above; stipules lanceolate, entire or incised; leaflets 5 – 11, interruptedly pinnate, the alternate ones often smaller, cuneate-oblong, coarsely incised-serrate or dentate, the smaller leaflets 3 – 5-toothed; pedicels slender; sepals and the much smaller bractlets acuminate, 2 – 3″ long, equalling or exceeding the obcordate petals; carpels 10. — Saskatchewan (Douglas); Rocky Mts. of British America (Bourgeau), and Colorado (Nuttall; Porter; Gray). Scarcely more than a form of the last.

11. P. CRINITA, Gray. Appressed silky-villous, not at all tomentose; stems decumbent, 1° long; stipules lanceolate, entire; leaflets 9 – 15, mostly folded and falcately recurved, ½′ long, cuneate-oblong, obtuse, coarsely serrate, villous beneath, scarcely so or glabrous above; cyme loosely paniculate; sepals acute, nearly 3″ long, the bractlets a little shorter; petals obovate, retuse, exceeding the calyx; carpels 25 – 30. — Collected only by Fendler (199), near Santa Fé, New Mexico.

12. P. BREWERI. Alpine; stems decumbent at base, rather stout, 3 – 10′ long; densely white-tomentose throughout, the calyx and upper

leaves appressed silky-villous; stipules broad, mostly incised; leaflets 7 – 13, nearly uniform in size, 3 – 6″ long, broadly cuneate, deeply incised; cymes mostly crowded; flowers rather large, the emarginate petals 3 – 5″ long, much exceeding the calyx; carpels 20 – 25, on villous pedicels, the receptacle and disk hairy. — Mono Pass in the Sierra (1720 Brewer); summit above Cisco (Bolander).

13. P. PLATTENSIS, Nutt. Subalpine; pubescence throughout appressed silky-villous, scanty or nearly wanting; stems decumbent, slender, 3 – 12′ long; stipules linear-lanceolate to oblong, mostly entire; leaflets 7 – 13, usually crowded and often alternate, 2 – 6″ long, ovate, deeply incised-pinnatifid into 3 – 7 linear segments; flowers few, on slender pedicels, in an open cyme; petal 2 – 3″ long, usually exceeding the calyx, obovate and entire or retuse, or obcordate; carpels 25 – 40. — Rocky Mts. of Colorado. *P. diversifolia*, var. *pinnatisecta*, Watson (331 and 332), from the Clover Mts., Nevada, and the Uintas, must probably be referred here, though more densely silky, and the hairs upon the calyx spreading.

14. P. DISSECTA, Pursh. (*P. diversifolia*, *P. Drummondii*, and *P. rubricaulis*, Lehm.) Low, alpine, more or less silky-villous, with somewhat spreading hairs, or nearly glabrous; stems decumbent or ascending, 3 – 12′ long; stipules ovate- or oblong-lanceolate, entire; leaflets 5 – 7, or rarely but three, often glaucous, closely pinnate, or as frequently digitate, the upper one 1′ long or less, cuneate-oblong, incisely pinnatifid or serrate, the lowest often but trifid, the segments acute or acutish, and more or less tufted with white hairs; flowers few, on slender pedicels in an open cyme; calyx more or less villous with spreading hairs, the bractlets short, the lanceolate sepals shorter than the petals, which are 2 – 4″ long, obovate and retuse or obcordate; receptacle very villous; carpels 10 – 20, or more. — From British America to Colorado and California.

An examination of the original specimen of *P. dissecta* from "Hudson's Bay" in Herb. Banks (kindly made by Mr. Trimen of the British Museum) shows that it is but one of the several forms that have been referred to *P. diversifolia*, "from which it seems only to differ in its larger size, less amount of hairiness (the under side of the leaves only slightly pilose), and more deeply cut leaflets." Pursh's name must be retained as the oldest. A quite variable species, but strongly marked. The frequent form with nearly glabrous leaves is var. GLAUCOPHYLLA, Lehm. A rather stout and glabrous form with larger and more distant leaflets is *P. Drummondii*, Lehm. A subdigitate form with the leaflets linear-parted is var. MULTISECTA, Watson. *P. rubricaulis*, Lehm., appears to be a form with the leaflets subtomentose beneath, a case of rather rare occurrence.

Var. DECURRENS. Leaflets but three or with 1–2 additional distant pairs of smaller ones, the terminal leaflet cuneate-oblong, truncately 3-toothed, the upper pair 2–3-toothed, conspicuously decurrent, the lowest lanceolate and mostly entire; stem 1-flowered, 3′ high; glabrous throughout, excepting the villous calyx and tufted apices of the leaves. — 329 Watson, from peaks of the Uintas, at 12,000 feet altitude. A very peculiar form, perhaps distinct.

† † Leaves digitately 5–7-foliolate (rarely pinnate in *P. gracilis*); tomentose or villous.

15. P. GRACILIS, Dougl. (*P. Blaschkeana*, Turcz.) Villous and more or less tomentose; stems 2–3° high; stipules ovate or lanceolate, entire or subincised; leaflets mostly 7, sometimes 5, very rarely but 3, cuneate-oblong, obtuse, incisely serrate or pinnatifid, tomentose beneath, green above and subvillous or appressed-silky, 1–2½′ long; flowers in a loose subfastigiate cyme, the pedicels at length elongated and slender; calyx with the narrow bractlets shorter than the broad acute or lanceolate sepals; petals broadly obcordate, 3–4″ long, a little exceeding the calyx; carpels very numerous (40 or more). — From the Saskatchewan to Southern Alaska, and southward to New Mexico, Utah, and California. The leaflets occasionally show a tendency to a pinnate arrangement, and the species is distinguishable from the digitate form of *P. Hippiana*, var. *pulcherrima*, only by the more numerous carpels and the usually fewer and more deeply incised leaflets. Specimens like 159 Hall & Harbour tend to unite the two species.

Var. FLABELLIFORMIS. (*P. flabelliformis*, Lehm.) Differing only in the more deeply pinnatifid leaflets.

Var. FASTIGIATA (*P. fastigiata*, Nutt., *P. olopetala*, Lehm.) is a form, often low, with a shorter and more crowded cyme, the pubescence more dense and silky, especially upon the calyx and short pedicels.

Var. RIGIDA. (*P. rigida*, Nutt., not Wall. *P. Nuttallii*, Lehm.) A mostly stout and tall form, villous but without tomentum, the cyme loose or crowded, the leaves often large, 3–4′ long or more, and prominently veined beneath. — The leaves are occasionally decidedly pinnate, as in 162 Hall & Harbour. Certainly but a variety of *P. gracilis*.

16. P. ARGENTEA, L. Densely white-tomentose throughout and subvillous, excepting the smooth green upper surface of the leaves; stems short, ascending or decumbent; stipules lanceolate, entire, or toothed; leaflets 5, cuneate-obovate to narrowly oblanceolate, ½ – 1′ long, coarsely incised from above the base or only few-toothed towards the apex, the margin mostly revolute; flowers few to many, in a close or loosely panicled cyme, the pedicels short or often slender and elongated; sepals and bractlets equal, acute; petals obovate, 2″ long or less, equalling the calyx; achenia very numerous, dotted; style short but rather slender. — New England to Canada and Michigan.

17. P. HUMIFUSA, Nutt. (*P. concinna*, Rich.) Densely white-tomentose and silky-villous; stems decumbent, 2 – 4′ long, slender; leaflets 5, cuneate-oblong, 6 – 9″ long, green and appressed-silky above, only the rounded or truncate apex serrate with 3 – 5 teeth; flowers 3 – 5, on slender pedicels; bractlets narrow, shorter than the acute sepals; petals 2 – 3″ long, obcordate, exceeding the calyx; carpels 15 – 20. — From the Saskatchewan to the Rocky Mts. of Colorado.

† † † Leaves ternate (quinate in *P. maculata*, and very rarely quinate or pinnately 5-foliolate in *P. nivea*); low, arctic or alpine, sparingly villous or subglabrous (densely tomentose or villous in *P. nivea* and *fragiformis*); flowers few, in a loose cyme, or solitary, the obcordate petals exceeding the calyx; carpels 10 – 40.

18. P. NIVEA, L. (*P. Vahliana*, Lehm.) Pubescence silky-villous, often abundant, densely white-tomentose on the under side of the leaves and sometimes upon the calyx; stems 2 – 12′ high; leaflets cuneate-obovate or -oblong, 3 – 8″ long, coarsely incised-serrate or pinnatifid, the terminal one sessile or petiolulate; flowers few or solitary on slender pedicels; bractlets acute or acutish, shorter than the sepals; petals 2 – 4″ long; carpels few or many. — Labrador, Greenland, throughout Arctic America and in the Rocky Mts. southward to Colorado and the Uintas. *P. Vahliana* seems to be but a reduced large-flowered form. The var. *concolor*, R. Br., without tomentum, is to be referred to *P. emarginata*, having the peculiar calyx of that species. Most Labrador and some Greenland specimens, which have been considered *P. nivea*, are for the same reason rather to be carried to *emarginata*, though more or less tomentose. Some Rocky Mountain specimens so simulate reduced forms of *P. Hippiana* or *gracilis*, that, but for their ternate leaves, they might as well be so considered. The following variety makes the connection yet more close.

Var. DISSECTA. Leaves digitately or pinnately 5-foliolate, the leaflets deeply pinnatifid; dwarf, the stems 1 – 2′ high, 1 – 3-flowered. — In the Rocky Mts. of British America and Montana (368 Drummond; Douglas; Howard); and in the Uintas, Utah (335 Watson, in part), at 12,000 feet altitude.

19. P. FRAGIFORMIS, Willd. Villous with long silky hairs; stems ½ – 1° high; stipules large, oblong, acuminate; leaflets cuneate-obovate, 6 – 15″ long, sessile, coarsely incised-serrate; flowers few or solitary, very large; bractlets ovate, obtuse, shorter than the ovate acute sepals; petals obcordate, 3 – 6″ long, exceeding the calyx. — Aleutian Islands (Pallas); St. Paul's Island (Harrington).

Var. VILLOSA, Regel & Tiling. (*P. villosa*, Pall.) Densely white-tomentose, the upper surface of the leaves darker. — Alaska to Vancouver's Island; Mt. Ranier, Washington Territory (Tolmie).

20. P. MACULATA, Pour. (*P. Salisburgensis*, Hænke. *P. opaca*, Pursh, not L.) Sparingly villous with long spreading hairs, the pedicels subtomentose; stems ascending, 3 – 6′ high, loosely few-flowered; stipules ovate to lanceolate, entire; leaflets 5, rarely but 3, cuneate-obovate, ½ – 1′ long, rounded and incisely serrate at the apex; bractlets obtuse or obtusish, a little shorter than the acute sepals; petals cuneate-obcordate, 3 – 4″ long, exceeding the calyx. — Labrador; Greenland.

21. P. EMARGINATA, Pursh. (*P. nana*, Lehm. *P. nivea*, var. *concolor*, R. Br.) Rather more villous than the last, the pedicels densely tomentose, the leaves rarely tomentose beneath; stems ascending or erect, 1 – 3′ high; leaflets obovate, 2 – 6″ long, the terminal one shortly petiolulate or sessile, very coarsely incised, the 3 – 5 segments villous-tufted; flowers 1 – 2, mostly solitary; bractlets and sepals equal, broad, obtuse; petals 2 – 3″ long, considerably exceeding the calyx; carpels numerous. — Labrador; Greenland; Kotzebue Sound; Rocky Mountains (Drummond). *P. nana* is the more reduced form.

22. P. GELIDA, C. A. Meyer. (*P. flabellifolia*, Hook.) Nearly glabrous, with a scanty minute or villous pubescence; stems slender, 6 – 10′ high, 1 – 3-flowered; stipules oval or oblong, mostly entire; leaflets very broadly cuneiform, 6 – 9″ long, rounded at the apex and incisely 7 – 9-toothed, entire at base, the middle leaflet shortly petiolulate; bractlets and sepals nearly equal, obtuse or acute; petals 2 – 3″ long, obcordate, a little exceeding the calyx; carpels numerous. — Washington Territory and Oregon; Mt. Ranier (Douglas); Crater

Pass (Newberry); Cascade Mts. (Lyall). Our plant seems to accord perfectly with the Asiatic species.

23. P. Grayi. Pubescence scanty, villous; stems slender, 3 – 6′ high, 3 – 6-flowered; stipules ovate or oblong, entire; leaflets very broad and suborbicular, ½′ long, the truncate or rounded apex 5 – 7-toothed, the middle leaflet long-petiolulate; sepals acute, the bractlets but half as long and obtusish; petals 2 – 3″ long, orbicular, retuse, exceeding the calyx; carpels 15 – 20. — Yosemite Valley (Bolander; Gray); Lake Tenayo (Brewer); Gray's Peak, Colorado (Gray).

24. P. frigida, Vill. Very reduced, but ½ – 2′ high, villous; leaflets broadly cuneate-obovate, 3 – 5-toothed at the summit, 2 – 4″ long, nearly glabrous above; flowers solitary, small, on very slender stems; bractlets and sepals equal, obtuse; petals obcordate, 1½″ long, a little exceeding the calyx; carpels numerous, but achenia few. — White Mts., New Hampshire. Differing from the European plant only in its rather smaller flowers.

25. P. brevifolia, Nutt. Minutely glandular-puberulent, the calyx very sparingly villous; stems decumbent or ascending, 2 – 3′ high; stipules ovate, entire; leaflets suborbicular, 2 – 3″ long, 2 – 3-lobed and crenately toothed, the middle one petiolulate; bractlets acute, shorter than the acute sepals; petals "obovate," scarcely exceeding the calyx; style attached below the apex of the ovary. — Collected only by Nuttall; "Summit of Rocky Mts. (Oregon), near line of perpetual snow, near lat. 42°."

* * Style terminal or medial; carpels glabrous; disk thickened or glandular; stamens 20; herbaceous perennials, smooth or nearly so, with large purple or yellow flowers.

26. P. palustris, Scop. (*Comarum*, L.) Stems stout, ascending from a decumbent rooting perennial base, ½ – 2° long; glabrous below, minutely silky or glandular-pubescent above; lower stipules amplexicaul and long-adnate to the petiole, the upper broadly ovate, entire; leaves pinnate; leaflets 5 – 7, oblong, 1 – 2′ long, obtuse or acute, lighter-colored, and more or less pubescent beneath; flowers dark-purple, few, *in an open cyme*; calyx large and purplish, the sepals becoming 6 – 10″ long in fruit, the bractlets linear, acuminate, and much shorter; petals spatulate, acute, 2 – 3″ long; stamens with stout, fleshy filaments, in one row upon the margin of the thickened disk; carpels very numerous, sessile upon the large spongy receptacle; style attached

to the middle of the ovary. — New England, and from the Great Lakes northward to Greenland, the Arctic Circle, and Alaska.

27. P. Thurberi, Gray. Stems ascending, slender, 2° high; pubescence subvillous or minute; stipules ovate, incisely toothed; leaves digitate; leaflets 5 – 7, obovate to oblong, 2′ long, obtuse, nearly glabrous, coarsely serrate; flowers dark purple, in an open cyme; calyx large, the bractlets equalling the sepals; petals 3″ long, very broadly obcordate, equalling the calyx; disk thickened, pentagonal, bearing at the angles opposite to the sepals the 5 inner stamens with stout fleshy filaments, the 15 outer stamens with slender filaments arising from the margin of the base of the calyx; carpels numerous, sessile on the short hairy receptacle; style terminal. — New Mexico.

28. P. biflora, Willd. Dwarf, cæspitose, the ascending stems slender, 2 – 3′ high; pubescence villous, the pedicels subtomentose; leaves all radical, ternate; the middle leaflet petiolulate and 3-parted, the lateral 2-parted, the linear segments 3 – 6″ long with strongly revolute margins and villous-tufted, becoming nearly glabrous above; flowers 1 – 5, yellow; bractlets broad, equalling the acute sepals; petals cuneate-obcordate, 2½″ long, exceeding the calyx; disk glandular between the five inner stamens, lobed; filaments all subfiliform; carpels 15 – 30, short-pedicelled, the pedicels and small receptacle villous with long hairs; style attached below the apex of the ovary. — On the Arctic Coast and in Siberia. No American specimens found in our collections.

* * * Style attached below the middle of the ovary; carpels on short pedicels, and, with the receptacle, densely villous; disk not thickened; more or less woody perennials.

29. P. fruticosa, L. Shrubby, much branched, 1 – 4° high; pubescence silky-villous; stipules scarious; leaves pinnate; leaflets 5 – 7, crowded, oblong-lanceolate, 2 – 12″ long, entire, usually whiter beneath and the margins revolute; flowers on slender pedicels in rather loose cymes or solitary; bractlets equalling the acute sepals; petals yellow, orbicular, 2 – 6″ long, exceeding the calyx; stamens 30; carpels 20. — From New Jersey to Labrador and Wisconsin, and northward to the Arctic Circle and Behring Strait, and in the mountains to Colorado, Nevada, and Northern California.

Var. parvifolia. An alpine form, with minute densely silky leaves, 2″ long, and small flowers. — E. Humboldt Mts., Nevada, and in the Wahsatch.

30. P. TRIDENTATA, Soland. Caudex woody, creeping, branched and tufted, the ascending herbaceous stems 1 – 10′ high, subnaked; pubescence sparse, silky, appressed; stipules lanceolate, entire; leaves ternate; leaflets subcoriaceous and shining above, cuneate-oblong, ½ – 1′ long, 3 – 5-toothed at the truncate apex; flowers white, loosely cymose; bractlets nearly equalling the sepals, smoother; petals obovate-oblong, 2 – 3″ long, exceeding the calyx; stamens and carpels 20, the achenia becoming sparingly villous. — Higher peaks of the Alleghanies and White Mts.; coast of Massachusetts; Labrador; Greeenland; and from the Great Lakes to lat. 64°. *P. retusa*, Müller (*Fl. Dan.* 5, t. 799), is the older name by several years, but is less appropriate.

III. Style filiform, attached to the middle of the ovary or below the apex; peduncles axillary, solitary, 1-flowered; carpels glabrous, short-pedicelled, the pedicel and receptacle very villous; herbaceous perennials with mostly creeping or decumbent stems; flowers yellow.

31. P. ANSERINA, L. Spreading by slender many-jointed runners, white-tomentose and silky-villous; stipules many-cleft; leaves all radical, pinnate; leaflets 7 – 21, with smaller ones interposed, oblong, sharply serrate, silky-tomentose at least beneath; bractlets often incisely cleft, about equalling the sepals; petals oblong, broadly elliptical and entire or obcordate, 3 – 6″ long, exceeding the calyx; stamens 20, rarely 25; carpels 20 – 40; style attached to the middle of the ovary. — Pennsylvania to Illinois, New Mexico and California, and northward to the Arctic Ocean and Greenland. Very variable in size and pubescence, from the wholly glabrous minute plant of Greenland to the ordinary form with leaflets nearly or quite glabrous above or equally silvery-silky on both sides, and the still larger western form with leaves often 1 – 2° long.

32. P. CANADENSIS, L. Stems slender and decumbent or prostrate; pubescence villous, often scanty; stipules mostly entire; leaves ternate, the lateral leaflets parted nearly to the base, cuneate-oblong or -obovate, incisely serrate, nearly glabrous above; peduncles exceeding the leaves; bractlets longer than the sepals, entire; petals broadly obovate or obcordate, 2 – 3″ long; stamens 20; carpels 20 – 40; style attached

below the summit of the ovary. — Canada to Georgia and westward to Arkansas and the Saskatchewan.

Var. SIMPLEX, Torr. & Gray. With stouter and more ascending stems, 1 – 2° long, rarely creeping; less hairy.

33. P. NEMORALIS, Nestl. Stolons filiform; pubescence minute, appressed; leaves ternate, occasionally quinate; leaflets cuneate-obovate, 4 – 9″ long, subpetiolulate, coarsely serrate, sparingly villous; sepals and petals usually 4, the bractlets a little shorter; petals 2 – 3″ long, obcordate; style attached below the apex of the ovary. — Reported from Labrador and a specimen preserved in herb. Hooker, but collector not stated. Possibly not American.

Doubtful and Excluded Species.

P. DIGITATO-FLABELLATA, Br. & Bouch., is said to have originated from "North America." Tall and loosely corymbose; leaves quinate; leaflets slightly hairy above, subcanescent and tomentose beneath, cuneate-flabellate, trifid or incisely lobed, the unequal segments acute; bractlets equalling the sepals; petals obovate, subretuse, equalling or exceeding the calyx. Known only in cultivation in Europe.

P. MULTIJUGA, Lehm., appears both from the figure and description in Lehmann's *Revisio* to be *Horkelia Californica*, var. *cuneata*, except only that it is scarcely supposable that the peculiar characteristics of the flower could have escaped notice. No true *Potentilla* is found that answers to the description.

SYNONOMY.

31. POTENTILLA ANSERINA. Linn., Spec., 495. For foreign synonomy consult Lehmann's Monograph, p. 74, and Revisio, p. 188, and Ledebour, Fl. Ross., 2. 44. — Michx., Flora, 1. 304. James, Long's Exped., 2. 342. Cham. & Schlecht., Linnæa, 2. 24. Meyer, Pl. Lab., 76. Hook., Fl. Bor. Am., 1. 189. Bongard, Veg. Sitch., 132. Schlecht., Fl. Lab. in Linn., 10. 98. Hook. & Arn., Bot. Beech., 123 and 338. Torr. & Gray, Flora, 1. 444. Torrey, Frem. Rep., 89; Pac. R. R. Rep., 4. 84. Gray, Pl. Fendl., 42. Seemann, Bot. Herald, 29 and 52. Engelm., Pl. Upp. Miss., 191. Newberry, Pac. R. R. Rep., 6. 72. Cooper, Pac. R. R. Rep., 12. 38, 43, and 59. Hook. f., Distrib. Arc. Pl., 290. Bourgeau, Palliser's Rep., 256. Rothr., Fl. Alaska, 445. Gray, Manual, 155. Bolander, Cat., 12. Watson, King's Rep., 5. 89. — Collectors numerous.

Var. GRANDIS. Lehm. in Hook. Fl. Bor. Am., 1. 189; Revis., 190. Torr. & Gray, Flora, 1. 444. Ledeb., Fl. Ross., 2. 44.

Var. GRŒNLANDICA. Hook., Parry's 3d Voy., Appx., 125; Fl. Bor. Am., 1. 189.

Nestler, Monograph, 35. Seringe in DC. Prodr., 2. 582. Schlecht. in Linn., 10. 88. Torr. & Gray, Flora, 1. 444. Lehm., Revis., 190.

P. Egedii. Wormsk., Fl. Dan., 9. t. **1578.** Seringe, DC. Prodr., 2. 582. Spreng., Syst., 2. 535. Lehm., Monog., 74. Don's Mill., 2. 560. Dietr., Syn., 3. 189.

P. Anserina, var. *Egedii.* Torr. & Gray, Flora, 1. 444.

16. Potentilla argentea. Linn., Spec., 497. See Lehm., Monog., 94, and Revis., 96; Ledeb., Fl. Ross., 2. 47. — Pursh, Flora, 355. Torrey, Fl. U. S., 1. 497. Lehm.; Hook., Fl. Bor. Am., 1. 191. Torr. & Gray, Flora, 1. 441. Torr., Nicollet's Rep., 149. Gray, Manual, 154.

1. Potentilla arguta. Pursh, Flora, 636. Poir., Suppl., 4. 538. Richardson, Frankl. 1st Voy., Appx., 20. Lindl., Bot. Reg., 16. t. **1379.** Hook. (& Lehm.), Fl. Bor. Am., 1. 186, t. **63.** Don's Mill., 2. 558. Torr. & Gray, Flora, 1. 445. Walpers, Rep., 2. 35. Dietr., Syn., 3. 186. Torrey, Nicollet's Rep., 149; Fremont's Rep., 89. Engelm., Pl. Upp. Miss., 190. Lehm., Revis., 50. Cooper, Pac. R. R. Rep., 12. 43. Bourgeau, Palliser's Rep., 256. Gray, Manual, 154. — Bradbury; Richardson; James; Bourgeau; Lyall; Hall & Harbour; Hayden; Bebb; and others.

Geum agrimonioides. Pursh, Flora, 351. Spreng., Syst., 2. 543.

Boottia sylvestris. Bigelow, Fl. Bost., 2 ed., 206.

P. Pennsylvanica, var. *arguta.* Torrey, Ann. N. Y. Lyc., 2. 197; not Seringe in DC. Prodr.

P. confertiflora. Torrey, Flora U. S., 1. 449. Spreng., Syst., 4. 189. Lehm., Nov. Stirp., pug. 3. 24.

Var. ferruginea. Lehm., Revis., 50.

P. ferruginea. Dougl.; "Paxt. Mag., 5. t. **233.**"

P. Bigelowiana. Wenderoth, "Sem. h. Marb. 1841"; (Litt. Ber. zu Linn., 16. 112.)

28. Potentilla biflora. "Willd.; Schlecht., Mag. Ges. Nat. Berl., 7. 297." See Lehm., Monog. and Revis., and Ledeb., Fl. Ross.— Richardson, Franklin's 1st Voy., Appx., 21. Lehm., Monog., 192, t. **20**; Revis., 20, t. **62.** Cham. & Schlecht., Linn., 2. 24. Hook., Fl. Bor. Am., 1. 195. Hook. & Arn., Bot. Beech., 123. Torr. & Gray, Flora, 1. 442. Dietr., Syn., 3. 180. Ledeb., Fl. Ross., 2. 61. Seemann, Bot. Herald, 29. Hook. f., Journ. Linn. Soc., 1. 124; Distrib. Arc. Pl., 290. Rothr., Fl. Alaska, 445. — "Richardson; Beechey; Seemann; Rae."

25. Potentilla brevifolia. Nutt.; Torr. & Gray, Flora, 1. 442. Lehm., Revis., 46. Dietr., Syn., 3. 183. Walp., Rep., 2. 34. — Nuttall.

12. Potentilla Breweri. — No. 1720 Brewer; Bolander.

32. Potentilla Canadensis. Linn., Spec., 498. Michx., Flora, 1. 303. Nestler, Monog., 58, t. **10.** Elliott, Sketch, 1. 574. Torrey, Fl. U. S., 1. 426. Seringe, DC. Prodr., 2. 575. Spreng., Syst., 2. 538. Lehm., Monog., 118; Hook., Fl. Bor. Am., 1. 192; Revis., 187. Darlington, Fl. Cestr., 303. Don's Mill., 2. 552. Torr. & Gray, Flora, 1. 443. Engelm., Pl. Upp. Miss., 191. Cooper, Pac. R. R. Rep., 12. 43. Bourgeau, Palliser's Rep., 256. Chapman, Flora, 124. Gray, Manual, 154.

P. pumila. Poir., Dict., 5. 594. Pursh, Flora, 354. Spreng., Syst., 2. 573.

P. sarmentosa. Willd., Enum., 1. 554. Nestler, Monog., 64. Bigelow, Fl. Bost., 2 ed., 204. Dietr., Syn., 3. 180.

Var. SIMPLEX. Torr. & Gray, Flora, 1. 443. Lehm., Nov. Stirp., pug. 9. 72; Revis., 188. Gray, Manual, 154.

P. simplex. Michx., Flora, 1. 303. Nestler, Monog., 40, **t. 9**. Lehm., Monog., 118; Hook., Fl. Bor. Am., 1. 192. Elliott, Sketch, 1. 574. Seringe, DC. Prodr., 2. 575. Spreng., Syst., 2. 538. Don's Mill., 2. 552.

P. Caroliniana. Poir., Dict., 5. 595. Pers., Ench., 2. 55.

11. POTENTILLA CRINITA. Gray, Pl. Fendl., 41. Walpers, Ann., 2. 480. Lehm., Revis., 63, **t. 21**. — No. 199 Fendler.

14. POTENTILLA DISSECTA. Pursh, Flora, 355. Seringe, DC. Prodr., 2. 575. Spreng., Syst., 2. 536. Lehm., Nov. Stirp., pug. 3. 20; Revis., 28. Hook., Fl. Bor. Am., 1. 193. Don's Mill., 2. 553 and 560. Nuttall, Jour. Acad. Phil., 7. 20. Torr. & Gray, Flora, 1. 446. Dietr., Syn., 3. 180 and 190. — Wyeth; Nuttall; Drummond; Bourgeau; Lyall; 219 Parry; 2715 Brewer; 5084 Bolander; 327 Watson; 135 Hall.

P. diversifolia. Lehm., Nov. Stirp., pug. 2. 9; Hook., Fl. Bor. Am., 1. 190; Revis., 72, **t. 31**. Don's Mill., 2. 556. Torr. & Gray, Flora, 1. 439. Walpers, Rep., 2. 33. Dietr., Syn., 3. 185. Torrey, Fremont's Rep., 89. Engelm., Pl. Upp. Miss., 191. Bourgeau, Palliser's Rep., 256 and 262; Gray, in Am. Jour. Sci., 2 ser., 33. 411. Watson, King's Rep., 5. 86.

P. Drummondii. Lehm., Nov. Stirp., pug. 2. 9; Hook., Fl. Bor. Am., 1. 189, **t. 65**; Revis., 66. Don's Mill., 2. 558. Torr. & Gray, Flora, 1. 439. Walpers, Rep., 2. 32. Dietr., Syn., 3. 178. Bourgeau, Palliser's Rep., 256. Gray, Proc. Acad. Phil., 1863, 61.

P. rubricaulis. Lehm., Nov. Stirp., pug. 2. 11; Hook., Fl. Bor. Am., 1. 191; Revis., 68, **t. 30**. Don's Mill., 2. 556. Torr. & Gray, Flora, 1. 438. Walpers, Rep., 2. 32. Dietr., Syn., 3. 185.

Var. GLAUCOPHYLLA. Lehm., Revis., 73. Watson, King's Rep., 5. 86, in part. — Burke; 218 Parry; 171 Vasey; 328 Watson.

P. glaucophylla. Lehm., Del. Sem. h. Hamb., 1836, 7; (Litt. Ber. zu Linn., 1838, 83.) Walpers, Rep., 2. 33.

Var. MULTISECTA. Watson, King's Rep., 5. 86. — No. 159 Hall & Harb., in part; 330 Watson.

Var. DECURRENS. — No. 329 Watson.

10. POTENTILLA EFFUSA. Dougl.; Lehm., Nov. Stirp., pug. 2. 8; Hook., Fl. Bor. Am., 1. 87; Revis., 64, **t. 22**. Don's Mill., 2. 557. Torr. & Gray, Flora, 1. 437. Dietr., Syn., 3. 186. Walpers, Rep., 2. 32. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 219. Engelm., Pl. Upp. Miss., 191. Bourgeau, Palliser's Rep., 256. — Douglas; Nuttall; Bourgeau; Porter; Gray.

Var. GOSSYPINA. Torr. & Gray, Flora, 1. 437. Lehm., Revis., 64.

P. gossypina. Nutt.; Hook., Pl. Geyer in Lond. Jour. Bot., 6. 219.

21. POTENTILLA EMARGINATA. Pursh, Flora, 353. Lehm., Monog., 174; Revis., 161. Spreng., Syst., 2. 540. Hook., Fl. Bor. Am., 1. 194. E. Meyer, Fl. Lab., 74. Don's Mill., 2. 551. Torr. & Gray, Flora, 1. 446. Hornem., Fl. Dan.,

13. **t. 2291.** Dietr., Syn., 3. 179. Seemann, Bot. Herald, 29, 51, and 56. Rothr., Fl. Alaska, 445. — Franklin; Parry; Drummond; Kane; Hayes.

P. nana. "Willd., Mag. Berl., 7. 296." Lehm., Monog., 181, **t. 17**; (Spreng., Neue Entdeck., 2. 298;) Hook., Fl. Bor. Am., 1. 194. Seringe in DC. Prodr., 2. 573. Spreng., Syst., 2. 541. Don's Mill., 2. 550. Hook. & Arn., Bot. Beech., 123. Torr. & Gray, Flora, 1. 441. Dietr., Syn., 3. 179. Ledeb., Fl. Ross., 2. 56. Seller, Ann. & Mag. Nat. Hist., 1 ser., 16. 170. Seemann, Bot. Herald, 29 and 55. Hook. f., Jour. Linn. Soc., 1857, 121. Rothrock, Fl. Alaska, 445.

P. verna. "Hook. in Scoresby's Greenland, 421."

P. Grœnlandica. R. Br., Ross's Voy., 142.

P. nivea, var. *concolor.* R. Br., Parry's 1st Voy., Appx., 277. Hook., Parry's 2d Voy., Appx., 395. Torr. & Gray, Flora, 1. 441.

P. nivea, var. *arctica.* Lehm., Revis., 167, in part.

" *P. frigida?* Greville, Mem. Wern. Soc., 4. 430."

P. nivea, var. *Vahliana.* Durand, in Kane's Exped., 2. 453; not Torr. & Gray.

19. Potentilla fragiformis. "Willd. in Mag. Berl., 7. 294." Lehm., Monog., 163, **t. 15**; (Spreng., Neue Entdeck., 2. 298;) Hook., Fl. Bor. Am., 1. 194; Revis., 155. Seringe, DC. Prodr., 2. 586. Spreng., Syst., 2. 540. Don's Mill., 2. 550. Ledeb., Fl. Ross., 2. 59, with full synonymy. Dietr., Syn., 3. 178. Regel & Tiling; Fl. Ajan., 85, with syn. — Pallas; Dall.

Var. villosa. Regel & Tiling, l. c. — Mertens; Barclay; Tolmie; Scouler; Wood; Bischoff; Bannister; Harrington.

P. villosa. Pall.; Pursh, Flora, 353. Lehm., Monog., 166, **t. 16**; Hook., Fl. Bor. Am., 1. 194; Revis., 171. Seringe, DC. Prodr., 2. 573. Spreng., Syst., 2. 540. Cham. & Schlecht., Linn., 2. 22. Bongard, Veg. Sitch., 132. Don's Mill., 2. 550. Hook. & Arn., Bot. Beech. 123. Torr. & Gray, Flora, 1. 442. Dietr., Syn., 3. 178. Ledeb., Fl. Ross., 2. 58. Presl, Epimel. Bot., 198. Seemann, Bot. Herald, 29. Hook. f., Distrib. Arc. Pl., 290. Rothrock, Fl. Alaska, 445.

P. lucida. "Willd., Berl. Mag., 7. 296."

P. leucochroa. "Lindl., Wall. Cat. Pl. Ind."

24. Potentilla frigida. Vill., Fl. Delph., 3. 563. See synonymy in Lehm., Revis., 158. — Hook. f., Distrib. Arc. Pl., 290 and 326. Durand, Kane's Exped., 2. 454. Gray, Manual, 154.

P. Robbinsiana. Oakes, MS. in herb.

P. minima. Gray, Manual, 1 ed., 122.

P. minima, var. *Robbinsiana.* Torr. & Gray, Flora, 1. 441. Lehm., Revis., 159.

29. Potentilla fruticosa. Linn., Spec., 495. See synonymy in Ledeb., Fl. Ross., 2. 61, and Lehm., Revis., 16. — Michx., Flora, 1. 304. Pursh, Flora, 355. James, Long's Exped., 2. 215. Torrey, Ann. N. Y. Lyc., 2. 197; Fremont's Rep., 89. Hook., Fl. Bor. Am., 1. 186. Nuttall, Journ. Acad. Phil., 1834, 20. Hook. & Arn., Bot. Beech., 123. Torr. & Gray, Flora, 1. 445. Seemann, Bot. Herald, 29 and 51. Richardson, Arc. Exped., 427. Engelm., Pl. Upp. Miss., 191. Hook. f., Jour. Linn. Soc., 1. 124; Distrib. Arc. Pl., 290. Bourgeau, Palliser's Rep., 256

and 262. Regel, Gart. Flora, 9. t. **278**. Gray, Proc. Phil. Acad., 1863, 61. Rothrock, Fl. Alaska, 445. Gray, Manual, 155. Watson, King's Rep., 5. 89.

P. floribunda. Pursh, Flora, 355. Don's Mill., 2. 561.

Var. ALPINA. — No. 342 Watson; Wheeler.

22. POTENTILLA GELIDA. C. A. Meyer, Ind. Pl. Cauc., 167. Ledeb., Fl. Ross., 2. 59, with synonymy. Walpers, Rep., 2. 26. Lehm., Revis., 154, with synonymy. — Douglas; Newberry; Lyall; 4971 Bolander; 1685 Brewer.

P. flabellifolia. Hook.; Torr. & Gray, Flora, 1. 442. Dietr., Syn., 3. 183. Walpers, Rep., 2. 34. Lehm., Revis., 153, t. **51**. Newberry, Pac. R. R. Rep., 6. 72.

2. POTENTILLA GLANDULOSA. Lindl., Bot. Reg., 19. t. **1583**; (Litt. Ber. zu Linn., 1835, 13.) Hook. & Arn., Bot. Beech., 338. Torr. & Gray, Flora, 1. 446. Dietr., Syn., 3. 187. Walpers, Rep., 2. 35. Engelm., Pl. Upp. Miss., 191. Lehm., Revis., 48. Torrey, Pac. R. R. Rep., 4. 84; Bot. Mex. Bound., 64. Newberry, Pac. R. R. Rep., 6. 72. Watson, King's Rep., 5. 89. Bolander, Cat., 12. — No. 138 Coulter; 197 Fendler; 154 Hall & Harb.; 100 and 240 Stretch; 240 Anderson; 120 Torrey; 6296 Bolander; 260, 625, 1705, 1714, 1767, and 2715 Brewer; 343 Watson; 96 and 97 Eaton; 170 Vasey; 476 Greene; 211 Kell. & Harf.; 134 Hall; Douglas; Nuttall; Tolmie; Fremont; Wilkes; Wallace; Bigelow; Spalding; Cronkhite; Fitch; Smith; Parry; Heermann; Engelmann; Meehan.

P. arguta. Lehm., in Hook., Fl. Bor. Am., 1. 186, in part; not Pursh. Nuttall, Jour Acad. Phil., 7. 21.

P. Oregana and *glutinosa*. Nutt., MS. in herb.

P. fissa. Nuttall; Torr. & Gray, Flora, 1. 446. Dietr., Syn., 3. 187. Walpers, Rep., 2. 35. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 220. Gray, Pl. Fendl., 41; Amer. Jour. Sci., 2. 33. 411; Proc. Phil. Acad., 1863, 61.

P. Wrangeliana. Fisch. & Mey., Ind. Sem. h. Petr., 1840, Animad., 54. Walpers, Rep., 2. 35. Lehm., Revis., 49, t. **19**.

P. rupestris. Presl, Epimel. Bot., 198.

Var. INCISA. Lindl., Bot. Reg., 13. t. **1973**.

15. POTENTILLA GRACILIS. Dougl.; Hook., Bot. Mag., t. **2984**, and Fl. Bor. Am., 1. 192. Don's Mill., 2. 554. Torr. & Gray, Flora, 1. 440. Dietr., Syn., 3. 182. Walpers, Rep., 2. 33. Torrey, Fremont's Rep., 89. Lehm., Revis., 107. Cooper, Pac. R. R. Rep., 12. 52. Watson, King's Rep., 5. 88. — No. 159 Hall & Harb.; 269 Davidson; 336 Watson; 94 Eaton; 103 Greene; 136 Hall; Douglas; Nuttall; Tolmie; Pot. 3, Bourgeau; Kuhn; Parry.

P. Blaschkeana. Turcz.; Lehm. in Otto's Gartenz., 9. 506; Ind. Sem. h. Hamb., 1853, Add. 9; Revis., 107, t. **64**.

P. nivea, var. Bourgeau, Palliser's Rep., 256.

P. fastigiata? Gray, Proc. Phil. Acad., 1863, 61.

Var. FLABELLIFORMIS. Torr. & Gray, Flora, 1. 440. Newberry, Pac. R. R. Rep., 6. 72. Cooper, Pac. R. R. Rep., 12. 59. Durand, Fl. Utah, 163. Watson, King's Rep., 5. 88. — No. 1826 Brewer; 338 Watson; Nuttall; Bourgeau; Lyall; Spalding.

P. flabelliformis. Lehm., Nov. Stirp., pug. 2. 12; Hook., Fl. Bor. Am., 1. 192,

t. 66; Monog. Suppl., 13, **t. 6**. Don's Mill., 2. 554. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 220. Bourgeau, Palliser's Rep., 256.

Var. FASTIGIATA. — No. 513 Fremont; 203 Fendler; 74 Stretch; 1708 Brewer; 337 Watson; Nuttall; Scouler; Siler.

P. fastigiata. Nutt.; Torr. & Gray, Flora, 1. 440. Dietr., Syn., 3. 182. Walpers, Rep., 2. 33. Gray, Pl. Fendl., 42.

P. olopetala. Lehm., Revis., 78, in part.

P. concinna? Gray, Amer. Jour. Sci., 2. 33. 411.

Var. RIGIDA. — No. 162 Fremont; 98 Bridges; 162 Hall & Harb., in part, and 158, in part; 179 Anderson; 121 and 121a Torrey; 5036 Bolander; 339 Watson; 170 Hayden; 1144 Kell. & Harf.; Nuttall; Spalding; Cronkhite; Pot. 1, Bourgeau.

P. recta? Nutt., Genera, 1. 310.

P. chrysantha. Lehm. in Hook., Fl. Bor. Am., 1. 193. Don's Mill., 2. 554.

P. rigida. Nutt., Jour. Acad. Phil., 7. 20. Torr. & Gray, Flora, 1. 440. Walpers, Rep., 2. 33. Engelm., Pl. Upp. Miss., 191. Newberry, Pac. R. R. Rep., 6. 72.

P. Nuttallii. Lehm., Ind. Sem. h. Hamb., 1852, Add. 12; (Ann. Sci. Nat., 3. 19. 364;) "Otto's Gartenz., 8. 373"; Revis., 89, **t. 33**. Watson, King's Rep., 5. 88.

23. POTENTILLA GRAYI. — Nos. 9 and 4971 Bolander; 1685 Brewer; Gray.

9. POTENTILLA HIPPIANA. Lehm., Nov. Stirp., pug. 2. 7; Hook., Fl. Bor. Am., 1. 188, **t. 64**; Revis., 62. Don's Mill., 2. 558. — No. 389 Fremont; 216 Parry; 158 and 159 Hall & Harb., in part; 162 and 163 Vasey, and 172, in part; James; Douglas; Nuttall; Bourgeau; Woodhouse; Engelmann; Hayden; Greene.

P. leucophylla. Torrey, Ann. N. Y. Lyc., 2. 197; not Pall.

P. dealbata. Dougl., MS. in herb.

P. Pennsylvanica, var. *Hippiana.* Torr. & Gray, Flora, 1. 438. Torrey, Pac. R. R. Rep., 4. 84. Gray, Proc. Phil. Acad., 1863, 61.

P. diffusa. Torrey, Sitgreave's Rep., 159; not Gray.

Var. PULCHERRIMA. — No. 104 Fremont; 198 Fendler; 217 Parry; 160 Hall & Harb.; 161 and 164 Vasey; 333 and 334 Watson; Drummond; Bourgeau; Bigelow; Alford.

P. pulcherrima. Lehm., Nov. Stirp., pug. 2. 10; Hook., Fl. Bor. Am., 1. 190; Revis., 69, **t. 28**. Don's Mill., 2. 556. Watson, King's Rep., 5. 87.

P. Pennsylvanica, var. *pulcherrima.* Torr. & Gray, Flora, 1. 438.

P. diffusa. Gray, Pl. Fendler; not Willd. Torrey, Pac. R. R. Rep., 4. 84.

P. Hippiana, var. *diffusa.* Lehm., Ind Sem. h. Hamb., 1849, Add. 8; (Ann. Sci. Nat., 3. 12. 347;) Revis., 62. Walpers, Ann., 2. 480.

P. rubricaulis. Bourgeau, Palliser's Rep., 256; not Lehm.

7. POTENTILLA HOOKERIANA. Lehm., Ind. Sem. h. Hamb., 1849, Add. 10; Nov. Stirp., pug. 9. 18; (Ann. Sci. Nat., 3. 12. 353;) Revis., 163, **t. 55**. Walpers, Ann., 2. 509. — Bourgeau.

17. POTENTILLA HUMIFUSA. Nutt., Genera, 1. 310. Torrey, Ann. N. Y. Lyc., 2. 197. Seringe, DC. Prodr., 2. 574. — Bourgeau; Parry; 157 Hall & Harb.; 21 Greene.

P. concinna. Richardson, Frankl. 1st Voy., Appx., 20. Lehm., Monog. Suppl., 16, **t. 7**; Nov. Stirp., pug. 2. 13; Hook., Fl. Bor. Am., 1. 193, **t. 67**; Revis., 112. Don's Mill., 2. 554. Torr. & Gray, Flora, 1. 443. Dietr., Syn., 3. 183. Walpers, Rep., 2. 34. Bourgeau, Palliser's Rep., 256. Gray, Amer. Jour. Sci., 2. 33. 411; Proc. Phil. Acad., 1863, 61.

P. pulchella. Spreng., Syst., 4. 199; not R. Br.

Tormentilla humifusa. Don's Mill., 2. 562.

P. concinna, var. *humifusa.* Lehm., Revis., 112.

20. POTENTILLA MACULATA. Pourret, "Act. Toloss., 3. 316." E. Meyer, Pl. Lab., 75. Lehm., Revis., 119, with full synonymy. — Weiz; Kane; Williams; Rink; Butler.

P. Salisburgensis. Haenke; Jacq., Collect., 2. 68; Icon. Rar., 3. **t. 490.** Torr. & Gray, Flora, 1. 440.

P. opaca. Pursh, Flora, 355; not Linn. Meyer, Pl. Lab., 75. Lehm.; Hook., Fl. Bor. Am., 1. 191. Schlecht., Fl. Lab. in Linn., 10. 95. Torr. & Gray, Flora, 1. 191.

P. aurea. Oerder, Fl. Dan., **t. 114**; not Linn. Schrank, Pl. Lab.

P. aurea, var. *β.* Durand, Kane's Exped., 2. 455.

P. crocea. Hall. Hook. f., Jour. Linn. Soc., 1. 116.

33. POTENTILLA NEMORALIS. Nestler, Monog., 65. Lehm., Monog., 147, **t. 13**. Torr. & Gray, Flora, 1. 444. Ledeb., Fl. Ross., 2. 51, with synonymy.

P. procumbens. "Sibth.; Hartm. Handb., 5 ed., 164." Lehm., Revis., 179, with full synonymy.

P. Tormentilla. Seller in Ann. & Mag. Nat. Hist., 1. 16. 170.

18. POTENTILLA NIVEA. Linn., Spec., 499. Compare synonomy in Ledeb., Fl. Ross., 2. 57, Lehmann, Revis., 166, and Hook. f., Distrib. Arc. Pl., 325. — Vahl, Fl. Dan., **t. 1035**. Pursh, Flora, 353. R. Br., Parry's 1st Voy., Appx., 277; (Flora, 7. 2, Beilag., 88.) Richardson, Frankl. Journ., 2 ed., Appx., 20. Seringe, DC. Prodr., 2. 572. Cham. & Schlecht., Linnæa, 2. 21. Lehm., Monog., 73; Hook., Fl. Bor. Am., 1. 95. Meyer, Fl. Lab., 74. Torr. & Gray, Flora, 1. 441. See, mann, Bot. Herald, 52. Hook. f., Jour. Linn. Soc., 1. 116 and 121. Dickie, in same, 3. 111 and 11. 33. Gray, Am. Jour. Sci., 2. 33. 411; Proc. Acad. Phil., 1863, 61. Rothrock, Fl. Alaska, 445. Watson, King's Rep., 5. 87. — No. 193 Richardson; 214, 215 Parry; 335 Watson, in part; 172 Vasey, in part; Drummond; Bourgeau; Lyall.

Var. VAHLIANA. Seemann, Bot. Herald, 29.

P. hirsuta. Vahl; Hornem. in "Fl. Œcon., 2 ed., 500"; Fl. Dan., 8. **t. 1390**. Seringe, DC. Prodr., 2. 573.

P. Vahliana. Lehm., Monog., 172; Hook., Fl. Bor. Am., 1. 194; Revis., 170, with synonymy. Seemann, Bot. Herald, 51.

P. Jamesoniana. Grev., in "Mem. Soc. Wern., 3. 417, **t. 20**."

P. nivea, var. *γ.* Torr. & Gray, Flora, 1. 441. Durand, Kane's Exped., 2. 453.

Var. MACROPHYLLA. Lehm., Nov. Stirp., pug. 9. 57. Seringe, DC. Prodr., 2. 571, omitting syn. Hook., Bot. Mag., **t. 2982**.

P. nivea. R. Br., Parry's 1st Voy., Appx., 277. Lodd., Bot. Cab., **t. 460**.

Var. PROSTRATA. Lehm., Nov. Stirp., pug. 9. 69; Monog., 184; Revis., 169. Seringe, DC. Prodr., 2. 572.

P. prostrata. Rotböll, Skrift., 10. 453.

Var. PENTAPHYLLA. Lehm., Nov. Stirp., pug., 9. 69; Hook., Fl. Bor. Am., 1. 195; Revis., 169.

Var. DISSECTA. — No. 335 Watson, in part.

3. POTENTILLA NORVEGICA. Linn., Spec., 449. Oeder, Fl. Dan., t. 171. Michx., Flora, 1. 302. Ait., Hort. Kew., 2 ed., 3. 279. Nestler, Monog., 66. Elliott, Sketch, 1. 573. Lehm., Monog., 153; Revis., 198, with synonymy. Darlington, Fl. Cestr., 303. Cham. & Schlecht., Linnæa, 2. 26. Hook., Fl. Bor. Am., 1. 193. Bongard, Veg. Sitch., 132. Schlecht., Fl. Lab. in Linn., 10. 98. Torr. & Gray, Flora, 1. 436. Ledeb., Fl. Ross., 2. 36, with synonomy. Gray, Pl. Fendl., 42. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 219. Engelm., Pl. Upp. Miss., 191. Seemann, Bot. Herald, 51. Cooper, Pac. R. R. Rep., 12. 43 and 59. Chapman, Flora, 124. Bourgeau, Palliser's Rep., 256. Gray, Manual, 154. Watson, King's Rep., 5. 85. — No. 205 Fendler; Eschscholtz; Bourgeau; Lyall; Kellogg; Hayden; Howard; and others.

P. Labradorica. Lehm., Ind. Sem. h. Hamb., 1849, Appx., 12; (Ann. Sci. Nat., 3. 12. 355;) Nov. Stirp., pug. 9. 21; Revis., 201. Walpers, Ann., 2. 516.

P. millegrana and *grossa.* Dougl. MS.

Var. HIRSUTA. Torr. & Gray, Flora, 1. 436. Lehm., Nov. Stirp., pug. 9. 75; Revis., 199.

P. Monspeliensis. Linn.; Willd., Spec., 2. 1109.

P. hirsuta. Michx., Flora, 1. 302. Pursh, Flora, 353. Nestler, Monog., 67. Lehm., Monog., 155. Spreng., Syst., 2. 540. Hook., Fl. Bor. Am., 1. 193. Don's Mill., 2. 551.

P. Morisoni. DC., Hort. Monsp., 135. Seringe, DC. Prodr., 2. 573.

26. POTENTILLA PALUSTRIS. Scop., Fl. Carn., 2 ed., 1. 359. Lehm., Monog., 52; Revis., 73, with synonomy. Torrey, Flora U. S., 1. 498. Seringe, DC. Prodr., 2. 583. Meyer, Pl. Lab., 76. Hook., Fl. Bor. Am., 1. 187. Rothrock, Fl. Alaska, 445. Gray, Manual, 155.

Comarum palustre. Linn., Spec., 502. Müll., Fl. Dan., t. 636. Michx., Flora, 1. 302. Pursh, Flora, 156. Nutt., Genera, 1. 311. Richardson, Frankl. Journ., Appx., 2 ed., 12. Bigelow, Fl. Bost., 2 ed., 203. Schlecht., Fl. Lab. in Linn., 10. 98. Torr. & Gray, Flora, 1. 447. Seemann, Bot. Herald, 29. Newberry, Pac. R. R. Rep., 6. 71. Cooper, Pac. R. R. Rep., 12. 59. Hook. f., Distrib. Arc. Pl., 290. Irmisch, in Bot. Zeit., 19. 115. Bourgeau, Palliser's Rep., 256.

P. Comarum. Nestler, Monog., 36. Seringe, DC. Prodr., 2. 583. Cham. & Schlecht., Linn., 2. 25. Bongard, Veg. Sitch., 132.

6. POTENTILLA PENNSYLVANICA. Linn., Mant., 76. Compare synonomy in Ledeb., Fl. Ross., 2. 40, and Lehm., Revis., 57. — Ait., Hort. Kew., 2. 214. Michx., Flora, 1. 304. Pursh, Flora, 356. Nestler, Monog., 36. Lehm., Monog., 55; Hook., Fl. Bor. Am., 1. 187. Torr. & Gray, Flora, 1. 438, excl. vars. δ and ε. Gray, Pl. Fendl., 42. Cooper, Pac. R. R. Rep., 12. 43. Hook. f., Distr. Arc. Pl., 290 and 325 (under *P. sericea*). Bourgeau, Palliser's Rep., 256. Rothrock, Fl.

Alaska, 445. Regel & Herder, Pl. Semenov. in Bull. Soc. Mosc., 1. 474. Gray, Manual, 154. — Nos. 68, 216 Parry; 167 Vasey; Drummond; Nicollet; Burke; Pickering; Greene; Onion, Kinnicott & Hardisty.

P. Missourica. Schrad., Ind. Sem. h. Gött; (Linn., 8, Litt. Ber., 26.) Lindl., Bot. Reg., 17. **t. 1412**. Don's Mill., 2. 557.

Var. STRIGOSA. Pursh, Flora, 356. Lehm., ll. cc. Torr. & Gray, Flora, 1. 438. Engelm., Pl. Upp. Miss., 191. Gray, Am. Jour. Sci., 2. 33. 411; Proc. Phil. Acad., 1863, 61. — No. 162 Hall & Harb.; Nuttall; Bourgeau; Engelmann; Suckley; Kennicott.

P. pectinata. Fisch., MS.

P. holosericea. Nutt., MS., in herb.

P. absinthiifolia and *rubricaulis.* Dougl., MS.

Var. GLABRATA. — No. 326 Watson; Fremont.

P. sericea, var. *glabrata.* Lehm.; Hook., Fl. Bor. Am., 1. 189; Revis., 34. Don's Mill., 2. 560. Torr. & Gray, Flora, 1. 437. Torrey, Fremont's Rep. 89. Seemann, Bot. Herald, 29.

P. Pennsylvanica. Hook & Arn., Bot. Beech., 123.

P. Pennsylvanica, var. *strigosa.* Watson, King's Rep., 5. 86.

Var. ARACHNOIDEA. Lehm., Nov. Stirp., pug. 9. 41; Revis., 59.

P. arachnoidea. Dougl., MS.

P. Pennsylvanica, var. *conferta.* Gray, Pl. Fendl., 42, excl. syn.

Var. BIPINNATIFIDA. Torr. & Gray, Flora, 1. 438. Torrey, Nicollet's Rep., 149. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 220. Lehm., Revis., 60.

P. bipinnatifida. Dougl.; Hook., Fl. Bor. Am., 1. 188. Don's Mill., 2. 558.

P. arguta. Lehm., Monog., 62, excl. syn.; not Pursh. Cham. & Schlecht., Linn., 2. 26. Spreng., Syst., 2. 534.

P. Pennsylvanica, var. *arguta.* Seringe, DC. Prodr., 2. 581.

13. POTENTILLA PLATTENSIS. Nutt.; Torr. & Gray, Flora, 1. 439. Dietr., Syn., 3. 187. Walpers, Rep., 2. 32. Lehm., Revis., 28, **t. 6**. Gray, Proc. Acad. Phil., 1863, 61. — No. 564 Fremont; 161 Hall & Harb.; 331, 332 Watson; 165 Vasey; Nuttall; Bourgeau; Porter; Greene.

P. campestris. Nutt., MS. in herb.

P. sericea, var. *β.* Bourgeau, Palliser's Rep., 256.

? *P. diversifolia,* var. *pinnatisecta.* Watson, King's Rep., 5. 87.

8. POTENTILLA PULCHELLA. R. Br., Ross's Voy., 142; Parry's Voy., Suppl., 277; (Flora, 7. 2, Beilag., 87.) Hook., Parry's 2d Voy., Appx., 395. Lehm., Monog., Suppl., 14. **t. 7**; Nov. Stirp., pug. 3. 25; Hook., Fl. Bor. Am., 1. 191; Revis., 36. Seringe, DC. Prodr., 2. 502. Spreng., Syst., 4. 198. Hornem., Fl. Dan., 13. **t. 2234**. Don's Mill., 2. 586. Torr. & Gray, Flora, 1. 439. Dietr., Syn., 3. 185. Walpers, Rep., 2. 33. Seemann, Bot. Herald, 29. Durand, Kane's Exped., 2. 453. — Parry; Kane; Hayes.

P. sericea. Grev., "Mem. Soc. Wern., 3. 430."

P. Keilhavii. Sommerf., "Fl. Spitz. in Mag. Naturv., 2. 244."

4. POTENTILLA RIVALIS. Nutt.; Torr. & Gray, Flora, 1. 437. Dietr., Syn 3. 178. Walpers, Rep., 2. 31; Ann., 2. 515. Gray, Pl. Fendl., 42. "Otto's Gartenz., 7. 350"; Ind. Sem. h. Hamb., 1851, Add., 10; (Linnæa, 25. 313.) Torrey

Pac. R. R. Rep., 4. 84. Gray, Ives's Rep., 11. Bolander, Cat., 12. — No. 203 Fendler; 173 Vasey; Nuttall; Bigelow; Fitch.

Var. MILLEGRANA. — No. 122 Torrey; 240 Anderson; 1858 Brewer; 324, 325 Watson; 98 Eaton; 169, 173 Vasey; 216 Kell. & Harf.; Cooper.

P. millegrana. Engelm.; Lehm., Ind. Sem. h. Hamb., 1849, Add., 11; (Ann. Sci. Nat., 3. 12. 354); Nov. Stirp., pug. 9. 22; Revis., 202. Walpers, Ann., 2. 517. Watson, King's Rep., 5. 85.

Var. PENTANDRA. — Engelmann.

P. pentandra. Engelm.; Torr. & Gray, Flora, 1. 447. Dietr., Syn., 3. 184. Walpers, Rep., 2. 35. Lehm., Nov. Stirp., pug. 9. 75; Revis., 197, t. **62**.

5. POTENTILLA SUPINA. Linn., Spec., 497. See synonymy in Ledeb., Fl. Ross., 2. 36, and Lehm., Revis., 193. — Michx., Flora, 1. 304. Pursh, Flora, 1. 356. Torrey, Ann. N. Y. Lyc., 2. 197. Hook., Fl. Bor. Am., 1. 187; Comp. Bot. Mag., 1. 25. Nees, Pl. Neuwied., 8. Maximowicz, Fl. Amur., 97. Bourgeau, Palliser's Rep., 256. — Nuttall; Nicollet; Parry; Engelmann; Culbertson.

P. paradoxa. Nutt.; Torr. & Gray, Flora, 1. 437. Walpers, Rep., 2. 32. Torr., Nicollet's Rep., 149; Bot. Mex. Bound., 64. Gray, Pl. Wright., 1. 68 and 2. 55. Lehm., Nov. Stirp., pug. 9. 74; Revis., 194, t. **62**. Engelm., Pl. Upp. Miss., 191. Cooper, Pac. R. R. Rep., 12. 43. Paine, Cat. Pl. Oneida, 186. Gray, Manual, 154.

Var. NICOLLETII. — 361 Nicollet.

27. POTENTILLA THURBERI. Gray, Pl. Thurb., 318. Lehm., Ind. Sem. h. Hamb., 1854, 10; (Ann. Sci. Nat., 4. 2. 376;) "Otto's Gartenz., 10. 459"; Revis., 92. Torrey, Bot. Mex. Bound., 64. Müller, Ann., 7. 868. — No. 1107 Thurber; 347 Bigelow; Henry.

30. POTENTILLA TRIDENTATA. Aiton, Hort. Kew., 2. 216, t. **9**. Vahl, Symb. Bot., 2. 59. Michx., Flora, 1. 302. Nestler, Monog., 66. Lehm., Monog., 190; Hook., Fl. Bor. Am., 1. 195; Revis., 22. Richardson, Frankl. Journ., Appx., 12. Torrey, Flora U. S., 1. 495. Seringe, DC. Prodr., 2. 585. Spreng., Syst., 2. 514. Don's Mill., 2. 552. Torr. & Gray, Flora, 1. 445. Hook. f., in Journ. Linn. Soc., 5. 83. Durand, Kane's Exped., 2. 454. Chapman, Flora, 124. Bourgeau, Palliser's Rep., 256. Matthews, Fl. Acad., 15. Gray, Manual, 124.

P. retusa. Müll., Fl. Dan., 5. t. **799**. Retz, Fl. Scand., 2 ed., 123. Hornem., Fl. Dan., 11. t. **1875**. Don's Mill., 2. 550.

Cross-References.

P. absinthiifolia = P. Pennsylvanica, var.

P. arachnoidea. = P. Pennsylvanica.

P. arguta; P. glandulosa; P. Pennsylvanica.

P. aurea; P. maculata.

P. Bigelowiana = P. arguta.

P. bipinnatifida = P. Pennsylvanica, var.

P. Blaschkeana = P. gracilis.

P. campestris = P. Plattensis.

P. Caroliniana = P. Canadensis.

P. chrysantha = P. gracilis, var.

P. Comarum = P. palustris.

P. concinna; P. gracilis.

P. confertiflora = P. arguta.

P. crocea; P. maculata.

P. dealbata = P. Hippiana.

P. depauperata = Ivesia depauperata.

P. diffusa; P. Hippiana.

P. diversifolia; P. dissecta; P. Plattensis.
P. Drummondii = P. dissecta.
P. Egedii = P. Anserina, var.
P. fastigiata; P. gracilis.
P. ferruginea = P. arguta.
P. fissa = P. glandulosa.
P. flabellifolia = P. gelida.
P. flabelliformis = P. gracilis, var.
P. floribunda = P. fruticosa.
P. frigida = P. emarginata.
P. glaucophylla = P. dissecta, var.
P. glutinosa = P. glandulosa.
P. gossypina = P. effusa.
P. Grœnlandica = P. emarginata.
P. grossa = P. Norvegica.
P. hirsuta; P. nivea; P. Norvegica.
P. holosericea = P. Pennsylvanica, var.
P. Jamesoniana = P. nivea, var.
P. Keilhavii = P. pulchella.
P. Labradorica = P. Norvegica.
P. leucochroa = P. fragiformis, var.
P. leucophylla = P. Hippiana.
P. lucida = P. fragiformis, var.
P. millegrana; P. Norvegica; P. rivalis.
P. minima; P. frigida.
P. Missourica = P. Pennsylvanica.
P. Monspeliensis = P. Norvegica.
P. Morisoni = P. Norvegica.
P. multijuga = Horkelia Californica, var.
P. nana = P. emarginata.
P. Newberryi = Ivesia gracilis.
P. nivalis, Torr. = Geum Rossii.
P. nivea; P. emarginata; P. gracilis.
P. Nuttallii = P. gracilis, var.
P. olopetala = P. gracilis, var.
P. opaca; P. maculata.
P. Oregana = P. glandulosa.
P. paradoxa = P. supina.
P. pectinata = P. Pennsylvanica, var.
P. Pennsylvanica; P. arguta; P. Hippiana.
P. pentandra = P. rivalis, var.
P. procumbens; P. nemoralis.
P. prostrata; P. nivea.
P. pulchella; P. humifusa.
P. pulcherrima = P. gracilis, var.
P. pumila = P. Canadensis.
P. recta; P. gracilis.
P. retusa = P. tridentata.
P. rigida; P. gracilis, var.
P. Robbinsiana = P. frigida.
P. rubricaulis; P. dissecta; P. Hippiana; P. Pennsylvanica.
P. rupestris = P. glandulosa.
P. Salisburgensis = P. maculata.
P. sarmentosa = P. Canadensis.
P. sericea; P. Pennsylvanica; P. Plattensis; P. pulchella.
P. simplex = P. Canadensis, var.
P. Tormentilla = P. nemoralis.
P. Vahliana = P. nivea, var.
P. verna; P. emarginata.
P. villosa = P. fragiformis, var.
P. Wrangelliana = P. glandulosa.

Revision of the extra-tropical North American Species of the Genus Œnothera. — By SERENO WATSON.

The limits of this genus are retained as defined in Torrey & Gray's Flora, and by Bentham & Hooker, though *Godetia* and *Boisduvalia* might be removed from it with apparent safety. These sections are more nearly allied to *Clarkia* and *Eucharidion*, and are characterized by a similar attachment of the anthers to the filament by a broad and somewhat cordate base, by the same purple or lilac color of the petals, which in some species become strongly lobed, and (in *Godetia*) by the unusually uniform shape of the seeds, which resemble those of the two genera mentioned. In *Boisduvalia* we have also the calyx-lobes never reflexed, and the capsule few-seeded. The supposed affinity, however, of *Godetia* to *Epilobium*, on account of the analogy of the crest upon the seed of the one to the coma in the other, as held by Spach and admitted by Lindley, can scarcely be sustained.

A few new species are added, and some that had been reduced are restored; but the total number is little larger than that given by Torrey & Gray.

Synopsis of Species.

§ 1. EUŒNOTHERA. Stigma-lobes linear, elongated (very short in *Œ. linifolia*); calyx-tube linear, slightly dilated at the throat; petals never lilac or purple; filaments nearly equal; anthers linear, attached at the middle.

* Annual or biennial, caulescent; flowers erect before opening, yellow, the calyx tips free; capsules sessile, coriaceous, straight or nearly so; seeds in two rows in each cell.

† Flowers in a leafy spike; capsules oblong, slightly attenuate above; seed with more or less margined angles, nearly smooth.

Rather stout, erect, 1 – 5° high, usually simple; calyx-tube 1 – 2½′ long; capsule ¾ – 1′ long . . . . 1. *Œ. biennis.*

Thick and woody at base, 5 – 10° high; calyx-tube 3 – 5′ long; capsule 1 – 2′ long . . . . 2. *Œ. Jamesii.*

† † Flowers in a leafy spike; capsule linear; seeds not margined, minutely tuberculate.

Spike rather loose and few-flowered; calyx sparingly villous; petals roundish . . . . 3. *Œ. heterophylla.*

Spike elongated, dense; calyx silky-canescent; petals rhombic-ovate . . . . 4. *Œ. rhombipetala.*

† † † Flowers axillary; capsules linear.

Pubescence dense, short, appressed; leaves ¼ – 1′ long; capsule ½ – 1′ long, silky; seeds smooth; fls. small . 5. *Œ. humifusa.*

Pubescence longer and more spreading on the calyx and ovary; lvs. ½ – 2½′ long; capsule 1 – 2′ long; seeds obscurely pitted; fls. large . . . . 6. *Œ. Drummondii.*

More or less strigose-pubescent, calyx and ovary subvillous; capsule 1 – 1½′ long; seeds strongly pitted . . 7. *Œ. sinuata.*

* * Annual or perennial, caulescent; flowers nodding in the bud, white turning rose-color; capsules sessile, mostly linear; seeds in a single row.

Annual or biennial; calyx-tips not free, throat naked; seeds oval, not angled, finely pitted . . . . . 8. *Œ. pinnatifida.*

Annual; calyx very villous; the tips not free, throat naked; seeds smooth, lance-linear . . . . . 9. *Œ. trichocalyx.*

Perennial; calyx-tips free, throat naked; seeds smooth, lance-linear . . . . 10. *Œ. albicaulis.*

Perennial; calyx-tips short, free, throat very villous; capsule oblong; seeds ovate, angled, tuberculate . . 11. *Œ. coronopifolia.*

* * * Annual to perennial, caulescent; capsules obovate or clavate, often pedicelled, quadrangular, the valves ribbed and the angles more or less strongly winged (except in *Œ. linifolia*).

† Flowers yellow, erect in the bud.

Leaves linear-filiform, numerous; petals 1 – 3″ long; stigmas short; capsules 2 – 3″ long, sessile . . . . . 12. *Œ. linifolia.*

Leaves linear to oblanceolate, entire; fls. axillary, small; capsules pubescent, nearly sessile, slightly winged; Texan . . . . 13. *Œ. Spachiana.*

Leaves narrowly oblanceolate, entire; fls. loosely spiked, small; capsule glabrous, sessile or shortly pedicelled, slightly winged . . . . 14. *Œ. pumila*

Leaves ovate to linear, mostly denticulate; fls. subcorymbed, mostly ½ – 1′ long; capsule strongly winged, subsessile or short pedicelled . . . . . . 15. *Œ. fruticosa.*

Glabrous, subglaucous; leaves ovate to ovate-oblong; fls. larger, corymbose; capsule very broadly winged . . 16. *Œ. glauca.*

† † Flowers white or purple, nodding in the bud.

Calyx-tube as long as the ovary; petals white, large, obcordate . . . . 17. *Œ. speciosa.*

Calyx-tube shorter than the ovary; petals purple, small, entire . . . . 18. *Œ. rosea.*

* * * * Acaulescent or nearly so; flowers white or rose-color, erect in the bud; capsule ovate or ovate-oblong, obtusely or sharply angled, mostly sessile, large and rigid.

Capsule oblong, ribbed, often doubly crested on the angles; calyx-tube 2 – 7′ long; petals ¾ – 1¾′ long . . . . 19. *Œ. cæspitosa.*

Capsule ovoid-conical, not crested, scarcely angled, net-veined; calyx-tube 1 – 2′ long; petals 4 – 9″ long . 20. *Œ. primiveris.*

Capsule ovate, persistent, strongly winged, net-veined; calyx-tips free, the tube 2 – 4′ long; petals ½ – 1′ long . 21. *Œ. triloba.*

Capsule ovate, winged, more or less corky, smooth; calyx-tube 2 – 4′ long; petals 1½′ long, purplish; seed-testa thickened . . . . 22. *Œ. brachycarpa.*

Capsule 1 – 1½′ long, more attenuate upward, smooth, not corky; seed-testa not thickened . . . . . . 23. *Œ. Wrightii.*

* * * * * Caulescent perennials; flowers axillary, yellow except in *Œ. canescens*, calyx slightly dilated; capsule ovate to orbicular, strongly angled or broadly winged.

Low; capsule ovate, 3 – 4″ long, angled; petals white and rose-color, 6″ long; calyx-tube 6 – 8″ long . . . 24. *Œ. canescens.*

Low; capsule very silky, 8″ long, very broadly winged; calyx-tube 1 – 2′ long; petals ½ – 1′ long; seed not crested . . . . 25. *Œ. Fremontii.*

Capsule 1 – 3′ long, with wings nearly as broad; calyx-tube 2 – 5′ long; petals 1 – 2½′ long; seeds strongly crested . . . . 26. *Œ. Missouriensis.*

Glabrous; leaves ciliate, entire; calyx-tube 4 – 5′ long; petals 1 – 1½′ long . . . . 27. *Œ. microsceles.*

§ 2. TARAXIA. Stigma capitate; calyx-tube filiform, persistent; anthers attached at the middle, oblong; capsules sessile, linear to ovate, winged above in *Œ. graciliflora;* seeds in two rows. Mostly perennial and acaulescent; flowers yellow, erect in the bud.

Subpubescent; lvs. deeply pinnatifid; calyx-tube 3 – 6″ long; petals 3″ long . . . . 28. *Œ. breviflora.*

More densely pubescent; lvs. deeply pinnatifid; calyx-tube 1 – 2½′ long; petals 5 – 7″ long . . . . . 29. *Œ. Nuttalli.*

Glabrous; leaves lanceolate, nearly entire; calyx-tube 1 – 3′ long . . . . 30. *Œ. heterantha.*

Subpubescent; leaves often ovate, ciliate; filaments nearly equal; calyx-tube 1 – 4′ long . . . . . . 31. *Œ. ovata.*

Annual, small, hirsute; leaves linear, ciliate; calyx-tube ½ – 1½′ long; capsule truncately winged above, 5″ long . 32. *Œ. graciliflora.*

§ 3. MERIOLIX. Stigma discoid; calyx-tube more broadly dilated above; anthers oblong-linear, attached at the middle; capsule mostly sessile, linear-cylindric. Mostly perennial, somewhat woody, with axillary yellow flowers, erect in the bud.

Leaves numerous, linear to lanceolate, mostly entire; calyx-tube 1 – 2′ long, the tips free and linear; petals 4 – 12″ long; capsule 8 – 10″ long . . . . . 33. *Œ. Hartwegi.*

Shrubby and diffuse; lvs. ovate to oblong, 1 – 3″ long; fls. smaller; capsules ½′ long . . . . . . 34. *Œ. Greggii.*

Leaves linear to oblong-lanceolate, entire; calyx-tube 4 – 7″ long, the free tips short; petals 4 – 5″ long; capsules 4 – 7″ long, subpedicellate . . . . 35. *Œ. tubicula.*

Leaves linear to lanceolate, denticulate; the free calyx-tips short; capsules 9 – 15″ long . . . . 36. *Œ. serrulata.*

§ 4. SPHÆROSTIGMA. Stigma capitate; calyx-tube obconic or short-funnelform; anthers oblong, attached at the middle; capsule linear, sessile, attenuated above, curved and contorted. Annuals or biennials, with usually crowded bracteate or leafy spikes.

* Flowers white or rose-colored, in a nodding spike; capsule narrowly linear, terete, much contorted.

Canescently puberulent; leaves oblanceolate or oblong-lanceolate, entire or nearly so; capsule 8 – 12″ long, very slender, scarcely thicker at base . . . . . . 37. *Œ. alyssoides.*

Viscidly pubescent; leaves ovate, short-petioled, denticulate; capsule 6 – 9″ long, linear-fusiform . . . . 38. *Œ. Boothii.*

Glabrous; spike nearly erect; leaves lanceolate or narrowly oblanceolate, usually denticulate; capsule 8 – 15″ long, linear-fusiform . . . . 39. *Œ. gauræflora.*

* * Flowers yellow, turning green; stems leafy throughout; capsules linear, tetragonal, more or less contorted.

Canescently pubescent or rarely glabrous; lvs. thick, mostly entire; capsules 4 – 8″ long; maritime . 40. *Œ. cheiranthifolia.*

Somewhat hirsute; leaves denticulate; petals 4 – 7″ long, capsules $\frac{1}{2}$ – $1\frac{1}{2}$′ long . . . . 41. *Œ. bistortia.*

Somewhat hirsute; petals 1 – 2″ long; capsules 8 – 15″ long . . . . 42. *Œ. micrantha.*

* * * Flowers small, yellow, usually turning red; capsule very narrowly linear, subterete, slightly curved.

Subviscidly puberulent; leaves lanceolate; petals 1″ long . . . . 43. *Œ. chamænerioides.*

More or less hirsute; leaves linear; petals 2 – 4″ long, rarely reddening; capsules narrowly beaked . . 44. *Œ. dentata.*

Appressed puberulent or hirsute; leaves linear or lanceolate; petals 1 – 2″ long, usually reddening; capsules scarcely beaked, often short-pedicelled . . . . . 45. *Œ. strigulosa.*

* * * * Dwarf; flowers yellow, minute; capsule fusiform.

Canescently puberulent; capsules 3 – 6″ long . . 46. *Œ. andina.*

§ 5. CHYLISMIA. As in § 4, but capsules linear to clavate, pedicelled and obtuse; caulescent annuals.

* Racemes loose, naked, mostly few-flowered; seeds oblong-lanceolate.

Puberulent or nearly glabrous; leaves low on the stem, usually lyrately pinnatifid; calyx-tips not free; capsule 4 – 12″ long . . . . 47. *Œ. scapoidea.*

Villous, not puberulent; leaves the same; calyx-tips free, thick; capsules 1 – 3′ long . . . . 48. *Œ. brevipes.*

Canescently hirsute; leaves scattered, simple, cordate or ovate; capsules short-pedicelled . . . . . . 49. *Œ. cardiophylla.*

Glabrous; leaves pinnate with many nearly equal leaflets; calyx-tube very short, tips not free . . . . . 50. *Œ. multijuga.*

* * Flowers leafy-bracted, very small; seeds oblong, deeply concave on the inner side.

Dwarf, few-flowered, somewhat hispid . . . . 51. *Œ. pterosperma.*

§ 6. GODETIA. Stigma-lobes short, linear to ovate; calyx-tube obconic or short-funnelform; petals purple to rose-color; anthers oblong, fixed near the base, the petaline filaments shortest; capsule ovate to linear; seeds in one row, horizontal, angled, crested above.

* Capsule ovate to oblong, sessile; stems leafy; flowers in a strict mostly compact spike, erect in the bud.

Fls. crowded, large; petals 1 – 2′ long; stigmas linear; capsule 8 – 15″ long, short-pubescent, not costate . . 52. *Œ. grandiflora.*

Fls. mostly in a terminal cluster; petals 4 – 6″ long; stigma-lobes very short; capsule 6 – 9″ long, hairy, not costate . . . . 53. *Œ. purpurea.*

Fls. in a short simple spike; petals 3 – 12″ long; stigma-lobes very short; capsule bicostate upon at least the alternate sides . . . . 54. *Œ. lepida.*

Fls. small in numerous lateral spikelets, mostly in a crowded compound spike; capsule with at least the alternate sides bicostate, 3 – 6″ long . . . . 55. *Œ. albescens.*

* * Capsule linear; flowers scattered in a loose slender spike or raceme, nodding in the bud; stems less leafy.

† Capsules sessile.

Calyx villous, tube funnelform, tips free; capsules 8-costate, puberulent; stigma yellow . . . . . . 56. *Œ. Williamsoni.*

Ovary and capsule hairy; capsule mostly short, not costate; petals 3 – 6″ long; stigma yellow . . 57. *Œ. quadrivulnera.*

Capsule puberulent, 8 – 12″ long, not costate, petals 3 – 5″ long; stigma purple . . . . 58. *Œ. tenella.*

Stouter; petals 9 – 12″ long; capsule 8-costate, smoothish . . . . 59. *Œ. viminea.*

Ovary densely pubescent; style not exserted from the calyx-tube; filaments short; capsule with prominent sutures . . . . 60. *Œ. Romanzovii.*

† † Capsule pedicelled, not costate; stigma mostly yellow.

Capsule 1 – 1½′ long, attenuate each way; petals 8 – 15″ long; anthers purple; stigma-lobes 1½″ long . . 61. *Œ. amœna.*

Subglabrous; capsule 10 – 15″ long, long-pedicelled; petals 6 – 12″ long; stigma-lobes short; lvs. often repand-dentate; S. California . . . . 62. *Œ. Bottæ.*

Tomentosely puberulent; capsule 6 – 14″ long, short-pedicelled; petals 3 – 6″ long; stigma-lobes short . 63. *Œ. epilobioides.*

Calyx and ovary glandularly pubescent; capsule 4 – 9″ long, abrupt at base; stigma-lobes linear . . . 64. *Œ. hispidula.*

Puberulent; capsule abrupt at base, short-pedicelled; petals 2-lobed . . . . 65. *Œ. biloba.*

§ 7. BOISDUVALIA. Stigma-lobes short; calyx funnelform, the segments erect; petals 2-lobed, small, purple to white; anthers short; capsule ovate-oblong to linear-cylindric, nearly terete, thin, erect, sessile; seeds few, smooth, ovate-oblong; erect annuals.

Spike usually close and compound; floral bracts usually unlike the leaves; petals 3 – 6″ long; capsule ovate-oblong, 2 – 4″ long; seeds 1″ long; placenta large . 66. *Œ. densiflora.*

Spike simple; floral and cauline leaves similar; fls. very small; capsule linear, 4 – 6″ long; seeds smaller . .	67. *Œ. Torreyi.*
Glabrous; spike simple; leaves uniform; capsules ovate-oblong, 2 – 4″ long; placenta narrow	68. *Œ. glabella.*

§ 1. EUŒNOTHERA, Torr. & Gray. Lobes of the stigma linear, mostly elongated; tube of the calyx linear, slightly dilated at the throat; petals mostly flabelliform, obcordate or obovate, never lilac or purple; filaments nearly equal, often declined; anthers linear or linear-oblong, attached at the middle, versatile.

* Annual or biennial caulescent herbs; flowers erect before opening, yellow, usually turning to rose-color, nocturnal; tips of the calyx-segments free in the bud; capsule sessile, coriaceous, straight or nearly so, subtetragonal, the valves somewhat ribbed; seeds in two rows in each cell. — *Onagra*, Tourn.

† Flowers in a leafy spike; capsule stout, oblong, slightly tapering above; seeds oblong, angled, nearly smooth, the angles more or less margined.

1. Œ. BIENNIS, L. Erect, usually stout and mostly simple, 1 – 5° high, canescently puberulent and more or less hirsute or strigose; leaves lanceolate to oblong- or rarely ovate-lanceolate, 2 – 6′ long, acute or acuminate, repandly denticulate, the lowest petioled; calyx-tube rather slender, 1 – 2½′ long; petals ½ – ¾′ long; capsule more or less pubescent or hirsute, 3″ broad, 9 – 12″ long; seeds nearly 1″ long. — From lat. 56° to the Gulf, Texas, Nevada, and Oregon. The more strigose form is *Œ. muricata*, Murr.; the more softly pubescent is *Œ. Oakesiana.* The hairs often arise from a purple base.

Var. GRANDIFLORA, Lindl. Petals equalling the calyx-tube, 1 – 2½′ long. — Of equal range, but less common eastward. The broader leaved form is *Œ. Lamarckiana*, Ser.

Var. HIRSUTISSIMA, Gray. (*Œ. Hookeri*, Torr. & Gray.) Resembling var. *grandiflora*, but more hirsute, especially upon the ovary. — From New Mexico to California.

Var. CRUCIATA, Torr. & Gray. Flowers small, the petals very narrow or wholly wanting. An eastern form.

2. Œ. JAMESII, Torr. & Gray. Resembling the last, but much stouter and larger flowered. Stem 5 – 10° high, becoming thick and woody at base; pubescence appressed, canescently puberulent, with scattered substrigose hairs; spike becoming rather loose; calyx-tube rather thick, 3 – 5′ long; petals very broad, 1½ – 2½′ long; capsule 1 – 2′ long.

— On stream banks, from Western Texas to Southern Utah and Eastern Arizona.

† † Flowers in a leafy spike; capsule linear, ¾ – 1′ long, 1 – 1½″, thick; seeds oblong, the angles not margined, minutely tuberculate. Erect, 1 – 2° high; leaves 2 – 3′ long; calyx-tube slender, 1 – 1½′ long.

3. Œ. HETEROPHYLLA, Spach. (*Œ. bifrons*, Don.) Often branched above; pubescence usually sparse, strigose or hirsute, mostly subappressed; leaves lanceolate, acute, the lower attenuate at base, and occasionally sinuate-pinnatifid, the upper repand-denticulate, the uppermost oblong- to ovate-lanceolate, or subcordate; spike rather loose and few-flowered; calyx villous with scattered, spreading hairs; petals 8 – 12′ long, roundish, obtuse or subacute. — Texas.

4. Œ. RHOMBIPETALA, Nutt. Rarely branching, appressed-puberulent and subcanescent; leaves narrowly lanceolate, acuminate, denticulate, the lowest attenuate to a petiole and rarely pinnatifid, diminishing upwards into the close, elongated, conspicuously bracted spike, the uppermost often subcordate; calyx-tube very slender, the segments canescent with short, close, appressed hairs; petals rhombic-ovate, 6 – 10″ long, acute or acutish; filaments and elongated style filiform. — From Illinois to Minnesota, Kansas, and the Indian Territory.

† † † Flowers axillary; capsules linear, 1 – 1½″ thick.

5. Œ. HUMIFUSA, Nutt. Stems decumbent or ascending, ½ – 2° long; pubescence dense, canescent, short, appressed; leaves narrowly lanceolate or oblanceolate, ¼ – 1′ long, acute, sparingly repand-dentate or entire, the radical leaves pinnatifid; calyx-tube 1′ long or more, two to three times longer than the petals, the free tips of the segments short; capsule ½ – 1′ long, silky; seeds oblong, somewhat angular, smooth. — On the sea-coast from Cape May to Cape Florida.

6. Œ. DRUMMONDII, Hook. Stems decumbent or ascending, 1 –2° long, simple or branched; pubescence more or less dense, short, strigose, appressed, longer and more spreading on the calyx and ovary; leaves oblong-lanceolate or oblanceolate, ½ – 2½′ long, acute, attenuate to the base, entire or sparingly repand-denticulate, or subsinuate-toothed at base; calyx-tube 1 – 2′ long, rather thick, equalling or a little exceeding the petals; capsule 1 – 2¼′ long; seeds oblong or oval, very obscurely angled and obscurely pitted. — Coast of Texas. 35 *xantus*, a densely white-tomentose specimen from Cape St. Lucas, Lower Cali-

fornia, is perhaps to be referred here, rather than to *Œ. humifusa*, having the larger flower and elongated capsule, but with a larger, erect seed (¾″ long), very nearly smooth, and the calyx and ovary not villous.

7. Œ. SINUATA, L. Stems ascending or decumbent, simple or branched, about 1° high or more; more or less strigose-pubescent and puberulent; leaves oblong or lanceolate, 1 – 2′ long, sinuately toothed or often pinnatifid, the lower petioled; calyx and ovary subvillous, the slender tube ¾ – 1½′ long; petals 6 – 9″ long; capsule 1 – 1½′ long; seeds oblong, subangled, strongly pitted. — From New Jersey to Florida, the Indian Territory, Texas, and Mexico; Peru. *Œ. laciniata*, Hill, is the older name, but less appropriate. *Œ. prostrata*, Ruiz & Pav., is the same.

Var. MINIMA, Nutt., is a slender, reduced form, 1-flowered, often nearly glabrous.

Var. HIRSUTA, Torr. & Gray. Densely hirsute, with appressed and spreading hairs; seeds less strongly pitted.

Var. GRANDIFLORA. Flowers larger, the petals 1 – 1¼′ long; stems often decumbent. — Texas. Distinguished from *Œ. pinnatifida* by the yellow flowers erect before opening, the free calyx-tips, and the more oblong and angled seeds.

* * Annual or perennial caulescent herbs; flowers axillary, mostly large, nodding in the bud, white becoming rose-color, diurnal; capsules mostly linear, subtetragonal, sessile; seeds ascending in a single row in each cell. — *Anogra*, Spach.

8. Œ. PINNATIFIDA, Nutt. Annual or biennial; stem decumbent at base and diffusely branched, or subsimple and erect, 3 – 12′ high; canescently puberulent or subhirsute; leaves oblanceolate or linear-lanceolate, 1 – 3′ long, mostly deeply sinuate-pinnatifid with linear lobes, the lower spatulate and long-petioled, less deeply pinnatifid or entire; calyx-tube rather slender, equalling or a little shorter than the petals, the segments subvillous, tips not free, throat naked; petals emarginate, ¾ – 1¼′ long; capsules linear, 1 – 1½′ long, 1 – 1½″ wide, submembranous, more or less puberulent, erect or curved; seeds oval, apiculate, not angled, finely pitted. — East of the Rocky Mts., from Dakotah to the Indian Territory and New Mexico; Sonora.

9. Œ. TRICHOCALYX, Nutt. Annual; stem mostly stout, ½ – 1° high, erect or decumbent at base, simple or branched, white and shining; glabrous or canescently puberulent or subvillous; leaves linear to

oblong-lanceolate or rhomboidal, 2 – 4′ long, acute or acuminate, attenuate into a long petiole, repandly denticulate or sinuate-pinnatifid with irregularly unequal segments, or the lowest entire; calyx very villous, the bud obtuse, the tube slender, ½ – 1½′ long, throat naked; petals about equalling the tube, very broad, entire or deeply sinused; capsule linear, tapering upward, 1 – 2′ long, 1 – 3″ thick at the rigid and often contorted base; seeds lance-linear, smooth, ¾″ long, subangled. — From Western Wyoming to N. Eastern California, and on the eastern side of the Sierra to Arizona and New Mexico.

10. Œ. ALBICAULIS, Nutt. Stems from a perennial subterranean rootstock, erect, ½ – 4° high, simple or branched, white and often shreddy; glabrous or puberulent; leaves linear to oblong-lanceolate, 1 – 3′ long, sessile or attenuate at base or abruptly petioled, entire or repand-denticulate, or sinuate-pinnatifid toward the base; calyx with the tips of the segments free, the tube rather slender, ¾ – 1′ long, throat naked; petals equalling or somewhat shorter than the tube, suborbicular, entire or emarginate; capsule and seed as in the last. — A very variable species. From the Saskatchewan to Washington Territory, and eastward of the Sierra to Sonora and New Mexico.

Var. RUNCINATA, Engelm. Canescently puberulent, erect, diffusely branched; leaves narrowly lanceolate, coarsely dentate or sinuately pinnatifid the whole length. — New Mexico.

Var. CALIFORNICA. Weak and decumbent, densely hoary-pubescent with short, appressed, strigose hairs, and more or less villous; leaves lanceolate, repand-denticulate or sinuate-pinnatifid; flowers large, 2 – 3′ in diameter. — California; not collected in fruit, and perhaps distinct.

Var. BREVIFOLIA, Engelm. Very glabrous, erect, much branched; leaves broadly ovate, sessile, coarsely dentate, acutish or obtuse, 4 – 6″ long, dark green. — Collected only by Wislizenus (99) on sand-hills, south of El Paso in New Mexico.

Var. TRICHOCALYX, Engelm. Canescently hirsute, erect, sparingly branched; leaves lanceolate or lance-oblong, sessile, with a broad, truncate base, sinuate-dentate. — Also collected only by Wislizenus (473) at Las Vegas in New Mexico.

11. Œ. CORONOPIFOLIA, Torr. & Gray. Stems from a perennial subterranean rootstock, erect, ½ – 1½° high, branched; canescently puberulent, often more or less hispid; leaves narrowly oblanceolate, 1 – 2′ long, sinuately pinnatifid or more usually pectinate-pinnatifid, the linear

segments as broad as the rachis; calyx-segments with short, free tips, the tube ½′ long, with the throat densely villous; petals 4–8″ long; capsule oblong or linear-oblong, pubescent, 3–9″ long, 2″ or more broad; seeds large, ovate and angled, tuberculate-costate, subapiculate, ¾″ long. — From Nebraska to the Uintas, and southward to New Mexico.

* * * Annual to perennial caulescent herbs; flowers "mostly diurnal"; calyx-tube linear, the throat a little expanded; capsule obovate or clavate, often pedicelled, quadrangular, the ribs prominent, and the angles more or less prominently winged (except in *Œ. linifolia*), rather cartilaginous and rigid, the dissepiments often evanescent; seeds in double rows, small, oblong, angled. — *Œnotherium*, Seringe.

† Flowers yellow, erect in the bud. — *Kneiffia*, Spach.

12. Œ. LINIFOLIA, Michx. Annual or biennial, erect, very slender, simple or diffuse, 6–15′ high, glabrous, the branchlets and capsules puberulent; radical leaves oblanceolate, the cauline linear-filiform, ½–1′ long, numerous and fascicled; spike loosely flowered, the bracts short, ovate to lanceolate; calyx-tube ½–1″ long, slender, shorter than the ovary; petals 1–3″ long; stigmas short; capsules sessile, obovate, obtuse, 2–3″ long, not winged; seeds smooth. — From the Indian Territory to Louisiana and Texas.

13. Œ. SPACHIANA, Torr. & Gray. Annual, erect, simple or branched, 6–15′ high, puberulent; leaves linear to oblanceolate, 1–2′ long, obtuse, entire; flowers axillary; calyx-tube 3–4″ long, nearly equalling the petals; capsules pubescent, 5–7″ long, obovate-clavate, with a slender base, prominently ribbed, slightly winged towards the apex; seeds smooth. — Texas.

14. Œ. PUMILA, L. Closely resembling the last. Biennial, puberulent; stems ascending, 1–2° high; leaves mostly glabrous, entire, the radical spatulate, the cauline narrowly oblanceolate; spike loose, leafy; capsule glabrous, sessile or on a short pedicel. — From New England and Canada to the Saskatchewan, and southward to New Jersey, "and in the mountains to Georgia." *Œ. chrysantha* must be referred here.

15. Œ. FRUTICOSA, L. Biennial or perennial, erect, simple or branching above, often tall and rather stout, 1–3° high, villous-pubescent, puberulent or nearly glabrous; leaves ovate to narrowly lanceolate, 1–3′ long, usually acute, mostly repandly denticulate, sessile

or shortly petioled; flowers in close, repeated, leafy corymbs, or in a loose raceme; bracts linear; calyx-tube slender, 5 – 12″ long; petals $\frac{3}{4}$ – 1′ long; capsule obovate to clavate-oblong, 2 – 5″ long, more or less attenuate to the base, subsessile or with a pedicel shorter than the capsule, prominently ribbed and strongly winged, glabrous or pubescent, seeds very minutely tuberculate. — From Canada to Illinois, and southward to Florida and Louisiana. Very variable in the amount and character of the pubescence, in foliage, inflorescence, and size of the flowers.

Var. AMBIGUA, Torr. & Gray, may perhaps be distinguished as a smaller flowered form, the petals 2 – 8″ long, and with narrower lanceolate to linear leaves.

Var. LINEARIS. (*Œ. linearis*, Michx.) Rather sparsely pubescent or shortly villous; leaves linear to narrowly lanceolate, remotely repand-denticulate or entire; capsule about equalling or usually shorter than the pedicel, pubescent or glabrous, rather less broadly winged. — Atlantic States, from Connecticut to Florida and Louisiana. It seems impossible to maintain this as a distinct species.

To this must also be referred *Œ. riparia*, Nutt., with nearly glabrous, obscurely denticulate leaves, slightly hairy only on the margin and veins, as occasionally occurs in the typical form of the species. In Nuttall's original specimens the capsules are exactly as in *Œ. fruticosa*, and short-pedicelled. In other specimens the length of the pedicel is quite variable.

Var. HUMIFUSA, Allen. Perennial, low, decumbent or ascending, somewhat woody at base, diffusely branched, minutely appressed-pubescent; branches slender, flexuous; leaves linear to oblanceolate, $\frac{1}{2}$ – 1$\frac{1}{2}$′ long; petals 4 – 8″ long; capsules pubescent, about equalling the pedicel. — Suffolk County, Long Island. A remarkable form, strongly marked in its habit.

16. Œ. GLAUCA, Michx. Perennial, erect, 2 – 3° high, branching above, glabrous, subglaucous; leaves ovate to ovate-oblong, 2 – 4′ long, acute or obtusish, sessile, repand-denticulate; flowers in short, leafy corymbs; calyx-tube 6 – 10″ long; petals 9 – 15″ long, emarginate; capsule glabrous, ovoid-oblong, 4 – 5″ long, very broadly winged, usually very abruptly attenuate into a pedicel, equalling or shorter than the capsule. — In the mountains of Virginia and Kentucky, and southward to Northern Alabama.

† † Flowers white or purple, nodding in the bud, few in a loose

spike; capsule clavate-obovate, strongly 8-ribbed, rigid, sessile.— *Xylopleurum*, Spach.

17. Œ. SPECIOSA, Nutt. Stems from a perennial subterranean rootstock, erect or ascending, or subdecumbent, ½ – 2° high, branching; puberulent or canescently pubescent, rarely subvillous; leaves oblong-lanceolate to linear, 1 – 4′ long, acute, attenuate at base, repand-denticulate, sinuate-dentate, or more or less deeply sinuate-pinnatifid, especially at base, or the lower lyrately pinnatifid; calyx-tube rather thick, 4 – 8″ long, a little exceeding the ovary; petals ¾ – 1½′ long, white or rose-color, broadly obcordate or emarginate; capsule 7 – 9″ long, acute above, attenuate below into a terete or subangled base of half its length, nearly equally 8-costate by the thickened angles and prominent ribs; seeds very small, angled, scarcely tuberculate under a strong microscope. — From Kansas to Southern Texas.

18. Œ. ROSEA, Ait. Biennial or perennial, puberulent; stems ascending, 1 – 2° high, branching from the base; leaves lanceolate, 1 – 2′ long, acute or acuminate, attenuate to a petiole, repandly denticulate or entire, frequently sinuate-pinnatifid toward the base; calyx-tube slender, 2 – 4″ long, shorter than the ovary; petals purple or rose-color, about equalling the tube, rounded, entire; capsule as in the last, but seeds smoother. — From New Mexico and Arizona to Mexico; Peru.

* * * * Acaulescent or nearly so, mostly perennial; flowers axillary, erect in the bud, white or rose-color; calyx-tube elongated, somewhat dilated at the throat; capsule ovate or ovate-oblong, large and rigid, obtusely tetragonal or sharply angled, mostly sessile; seeds large, horizontal. — *Pachylophis* (and *Lavauxia* in part), Spach.

19. Œ. CÆSPITOSA, Nutt. Biennial or perennial, acaulescent or with a suberect stem, 2 – 6′ high, glabrous or more or less villous with spreading, subscabrous hairs; leaves oblong to narrowly lanceolate, 2 – 12′ long, attenuate to a long petiole, acuminate or acute, sometimes spatulate, irregularly sinuate-toothed or pinnatifid- or repand-denticulate; calyx-tube 2 – 7′ long, thick, 3 – 6″ wide at the throat, the tips of the segments not free in the bud; petals broadly obcordate, ¾ – 1¾′ long; capsules oblong, 1 – 2½′ long, 3 – 6″ thick, subattenuate at each end, sessile or short-pedicelled, strongly ribbed on the sides and often with a double crest along the sutures; seeds 1½″ long, in two rows in each cell, oval-oblong, not angled, very minutely and densely tubercled

upon the back with thin, flattened processes, and with a narrow, longitudinal furrow on the ventral side. — From the Upper Missouri to Nebraska, Nevada, New Mexico, and Sonora. The typical, wholly glabrous form appears to be found only on the Upper Missouri in Dakotah and Nebraska.

20. Œ. PRIMIVERIS, Gray. Annual or biennial, acaulescent or nearly so, often very small, more or less villous with spreading, substrigose hairs; leaves 1 – 4′ long, lyrate-pinnatifid or the lower oblanceolate and entire, narrowed into a petiole; calyx-tube 1 – 2′ long, slender, slightly dilated at the throat; petals obcordate, 4 – 9′ long; capsule ovoid-conical, not crested nor angled, ribbed and reticulately veined; seeds as in the last, but irregularly pitted, or rugose and very minutely tuberculate. — Western Texas and New Mexico.

21. Œ. TRILOBA, Nutt. Biennial or perennial, very rarely with a stem 1 – 2′ long, nearly glabrous; leaves 2 – 10′ long, somewhat ciliate, long-petioled, runcinate-pinnatifid or oblanceolate and only sinuately toothed, the segments usually repandly denticulate; calyx-tube slender, 2 – 4′ long, slightly dilated at the throat, the tips of the segments free; petals broadly obovate, ½ – 1′ long, subentire, 3-nerved; capsules persistent, oval or obovate, ¾ – 1¾′ long, acutely 4-toothed at the apex, strongly winged at the angles, the sides ribbed and reticulately veined; seeds 1″ long, angled, minutely and densely tuberculate. — From the Saskatchewan to Nevada and California, and southward to Texas, New Mexico, and Sonora.

22. Œ. BRACHYCARPA, Gray. Perennial, acaulescent or nearly so; pubescence canescent, short, usually dense, subtomentose; leaves rather thick, ovate to linear-lanceolate, 3 – 8′ long, long-petioled, usually lyrately pinnatifid, the lower, or sometimes all, entire or more or less deeply sinuate-toothed; calyx-tube 2 – 4′ long, thick, somewhat dilated upward; petals 1½′ long, broadly obcordate or entire, more or less purplish from the first; capsule ovate, 8 – 12″ long, ½′ broad, subattenuate upwards and subcompressed, rigid and coriaceous or corky, the angles winged, the sides smooth; seeds in two rows (or sometimes but one) in each cell, 1½″ long, with a thickened corky testa, strongly angled, crested at the summit, minutely tuberculate, somewhat rugose transversely at the base. — New Mexico. Flowering specimens, belonging either to this species or the next, have been collected in Western Texas and through Nevada to Montana.

23. Œ. WRIGHTII, Gray. Distinguishable from the last only by the

characters of the capsule, which is 1 – 1½′ long, more attenuated upwards, membranous-coriaceous and not corky. The seeds as known are imperfectly developed, but show little difference except in the want of the corky testa. As the fruit of *Œ. brachycarpa* is variable in these respects, it is probable that this may be only a form of that species. There may prove to be a distinguishing character, however, in the calyx, — the bud close and obtuse in *Œ. Wrightii*, acuminate and with free, slender tips in *Œ. brachycarpa*. — New Mexico.

* * * * * Caulescent perennials; flowers axillary, yellow, except in *Œ. canescens;* calyx-tube slightly dilated upwards; capsule short-pedicelled or sessile, ovate to orbicular, strongly angled or very broadly winged; seeds in one row in the cells. — *Megapterium*, Spach.

24. Œ. CANESCENS, Torr. Low, diffuse, ½° high; stems ascending or subdecumbent, leafy to the summit; pubescence canescent, minute, substrigose, appressed; leaves numerous, linear to narrowly lanceolate, 3 – 6″ long, entire or sparingly toothed; flowers near the ends of the branches; calyx-tube rather stout, 6 – 8″ long, the tips of the segments not free in the bud; petals broadly obovate, entire, ½′ long, white, spotted and tinged with rose-color; capsule ovate, 3 – 4″ long, sessile, acute, prominently angled, not strongly ribbed; seeds oblong, acute, angled, very nearly smooth. — From the upper waters of the Platte to New Mexico. The section *Gauropsis* was proposed by Dr. Torrey for this species, but the color of the flowers is the only prominent distinction.

25. Œ. FREMONTII. Stems low and tufted, 2 – 6′ high, simple, ascending; pubescence canescent, short and silky, dense and appressed; leaves narrowly lanceolate, 2′ long, acuminate, attenuate to a slender petiole, entire or obscurely denticulate; flowers below the ends of the branches; calyx-tube slender, 1 – 2′ long, the segment-tips free in the bud; petals emarginate, ½ – 1′ long; capsules 8″ long by ½′ wide, very broadly winged, rounded and not emarginate at the apex, on pedicels 1″ long or less, densely canescently silky; seeds 4 – 5 in each cell, oblong-ovate, not crested nor tuberculate. — Collected by Fremont on his second expedition (locality not given), by Dr. Bigelow (363) on the Mexican Boundary Survey at Santa Barbara in the Rio Grande Valley, and by Dr. Parry on dry, chalky hillsides near Smoky Hill, Kansas.

26. Œ. MISSOURIENSIS, Sims. Stems decumbent or ascending, simple or somewhat branched, very short or 1° or more long and sub-

woody at base; pubescence canescent, short and silky, closely appressed, sometimes dense or wholly wanting; leaves thick, oval to linear, mostly narrowly lanceolate, 2 – 5′ long, acuminate, attenuate to a usually slender petiole, entire or repand-denticulate; calyx-tube rather thick, 2 – 5′ long, the segments often spotted with purple, the tips free in the bud and slender; petals 1 – 2½′ long, broad, with usually a short abrupt acumination; capsules very broadly winged, 1 – 3′ long, nearly as wide, emarginate at the summit, shortly pedicelled, subcompressed, coriaceous-membranous, mostly glabrous; seeds 2″ long, strongly tuberculate, with a conspicuous crested border surrounding the upper end and extending partially down the ventral side in a double line. — From Missouri to Texas.

27. Œ. MACROSCELES, Gray. Perennial (or biennial?), glabrous; stems elongated; radical leaves spatulate to lanceolate, 7 – 12′ long, long-attenuate at base, acute, the cauline subsessile, oblong to lanceolate, all strigosely ciliate, entire; calyx-tube slender, 4 – 5′ long, the stout tips of the segments free in the bud; petals broadly obcordate, 1 – 1½′ long; fruit unknown; ovary 1′ long, linear, smooth, apparently with rudimentary wings. — This species from Northern Mexico, of Gregg's collection, was referred by Dr. Gray to the subsection *Onagra;* more perfect material is needed before its position can be determined.

§ 2. TARAXIA, Nutt. (Including § *Primulopsis,* Torr. & Gray.) Stigma capitate; calyx-tube filiform, funnelform at the summit, marcescent; anthers oval or oblong, attached near the middle, the petaline filaments shorter (nearly equal in *Œ. ovata*); capsule sessile, ovate or narrowly conical to linear, membranous, tetragonal (winged above in *Œ. graciliflora*); seeds ascending, in two rows in each cell, oblong, terete. Acaulescent or nearly so, the yellow flowers erect in the bud, tips of the calyx not free.

28. Œ. BREVIFLORA, Torr. & Gray. Perennial (or biennial), acaulescent, subpubescent or nearly glabrous; leaves lanceolate, 2 – 6′ long, petioled, acuminate, deeply sinuate-pinnatifid, the numerous very unequal segments acute or acutish, toothed or entire; calyx-tube 3 – 6″ long; petals becoming rose-color, 3″ long; capsule 6 – 10″ long, 1½ – 2″ broad below and attenuate above into the persistent calyx-tube, subtetragonal, subsulcate, and somewhat curved; seeds numerous, nearly 1½″ long, very minutely longitudinally striate.— Southern Wyoming, Colorado, and Eastern Utah.

29. Œ. Nuttallii, Torr. & Gray. (*Œ. tanacetifolia*, Torr. & Gray.) Resembling the last. Rarely shortly caulescent, more densely and canescently pubescent; segments of the leaves frequently rounded or obtuse; calyx-tube 1 – 2½′ long; petals 5 – 7″ long; capsules similar but rarely developed. — From Washington Territory to Northern California and Nevada.

30. Œ. heterantha, Nutt. Perennial, acaulescent, glabrous; leaves lanceolate to oblong-lanceolate, 3 – 6′ long, acute or acutish, attenuate at base into a petiole, rarely slightly repand-denticulate; calyx-tube 1 – 3′ long; petals 3 – 6″ long, not becoming reddish; capsule 9″ long, ovoid-oblong, tetragonal, attenuate above into the persistent calyx-tube, the sides nearly flat, ribbed, subreticulated; seeds numerous, ⅔″ long, minutely pitted. — From Idaho to Northern Nevada and Northern Utah.

Var. taraxacifolia. Leaves 1° long, lyrately pinnatifid; the capsules decidedly pedicillate. — A single immature specimen has been collected near Austin, Nevada; probably distinct.

31. Œ. ovata, Nutt. Resembling the last. Root very thick; subpubescent; leaves ovate to oblong-lanceolate, shortly ciliate, 2 – 8′ long, acute, erosely or repandly denticulate or serrulate; calyx-tube 1 – 4′ long; petals 3 – 10″ long; filaments nearly equal; capsule ½′ long, strongly torulose; seeds few, in one or two rows, erect, oval, 1″ long. — From San Francisco, California, to Monterey.

32. Œ. graciliflora, Hook. & Arn. Annual, acaulescent, small, villous; leaves linear, 1½ – 2½′ long, acuminate or obtuse, attenuate or more frequently broad at the base, entire or obscurely repand-denticulate, ciliate; calyx-tube ½ – 1½′ long; petals 3 – 5″ long, turning greenish; capsule compressed-ovate, 5″ long, coriaceous, tetragonal below and 4-winged above the middle, the wings obliquely truncate and hairy; seeds horizontal, smooth. — California, from the Sacramento River to Monterey.

§ 3. MERIOLIX, Raf. (*Calylophis*, Spach, and *Salpingia*, Nutt.) Stigma dilated, disciform; calyx-tube linear to funnelform, more or less broadly dilated at the mouth; petals yellow; anthers oblong-linear, attached at the middle, the filaments slightly unequal; capsule linear-cylindric, sessile or nearly so; seeds in two rows in each cell, ovoid or ovoid-oblong, strongly angled, very nearly smooth. Mostly perennial, caulescent, somewhat woody at base; flowers axillary, erect in the bud.

33. Œ. HARTWEGI, Benth. Suffruticose, usually low, 3 – 15′ high, decumbent or ascending, branched, more or less canescent or glabrous; leaves numerous, often crowded, linear to lanceolate, ½ – 2′ long, obtuse or acutish, entire or sometimes sparingly repand-denticulate; flowers mostly near the ends of the branches; calyx-tube often slender, 1 – 2′ long, 2 – 6″ broad at the throat, much exceeding the ovary, pubescent or glabrous, the segments with free linear tips; petals rhombic-ovate, acute or acutish, 4 – 12″ long; capsule 8 – 10″ long, 1 – 1½″ thick, sessile, erect, attenuate at base; seeds oval, very obscurely tuberculate. — From the Indian Territory to Western Texas and Northern Mexico.

Var. LAVANDULÆFOLIA. (*Œ. lavandulæfolia*, Torr. & Gray.) Low, 3 - 6′ higher, pubescent throughout, the leaves mostly linear, ¼ – 1′ long, the calyx-segments less attenuated above. — From Kansas and Colorado to Mexico.

Var. FENDLERI. (*Œ. Fendleri*, Gray.) Stouter, mostly glabrous, with oblong-lanceolate leaves and large flowers with a broad throat.

34. Œ. GREGGII, Gray. Scarcely more than a variety of the last. More shrubby and diffuse, low, viscidly pubescent or more or less hirsute; leaves ovate to oblong, 1 – 3″ long, acute, mostly sessile; flowers mostly terminal, the calyx-tube slender, 8 – 15″ long; petals acutish, 3 – 6″ long; capsule ½′ long. — New Mexico and Northern Mexico; on the Canadian River (Gordon).

35. Œ. TUBICULA, Gray. Biennial or perennial, usually sub-woody, diffusely branched, 4 – 12′ high, minutely glandular-puberulent; leaves linear to oblong-lanceolate, ½ – 1′ long, acute, entire, the lower petioled; calyx-tube 4 – 7″ long, 2″ broad in the throat, the segments short and ovate, with short, free tips; petals rounded-obovate, obtuse or acute, 4 – 5″ long; capsule 4 – 7″ long, 1″ broad, nearly terete, shortly pedicelled, dehiscing the whole length; seeds ovoid-oblong, ½″ long. — New Mexico and Northwestern Texas.

36. Œ. SERRULATA, Nutt. Slender, 3 – 15′ high, simple or branched, canescent with short, appressed hairs or nearly glabrous; leaves linear to lanceolate, 1 – 3′ long, mostly acute or acutish, attenuate to the base, irregularly and sharply denticulate; calyx-tube broadly funnelform, 2 – 4″ long, strongly nerved, the short ovate segments with short, free tips; petals broadly obovate, 3 – 4″ long, crenulate; capsules 9 – 15″ long, 1″ wide, subsulcate over the sutures, sessile, often narrowed to a slender base; seeds very small, ¼″ long. — From the Saskatche-

wan to Wisconsin, and westward of the Mississippi to Texas and New Mexico.

Var. SPINULOSA, Torr. & Gray. Usually nearly glabrous, the stems rather stout, subdecumbent, sometimes 2 – 3° long; flowers larger, the tube 6 – 10″ long, with a slender base and equalling the petals; the stigma and throat of the calyx occasionally very dark-purple or orange. — From the Indian Territory to Texas.

Var. PINIFOLIA, Engelm. Leaves very narrowly linear and subrevolute; flowers as in var. *spinulosa*. — Texas.

§ 4. SPHÆROSTIGMA, Spach. Stigma capitate; calyx-tube obconic or shortly funnelform; petals entire or emarginate; stamens somewhat unequal, the oblong anthers attached near the middle; capsules linear, sessile, terete or tetragonal, attenuated at the apex and more or less contorted; seeds ascending in a single row in each cell, ovate to linear-oblong, smooth or nearly so. Caulescent annuals or biennials, the spikes usually crowded, bracteate or leafy.

* Flowers white or rose-colored, in a nodding spike; calyx-tube funnelform; capsule narrowly linear, terete, much contorted; seeds linear, acute at each end.

37. Œ. ALYSSOIDES, Hook. & Arn. Canescently puberulent, usually branching from the base, 3′ – 1° high; leaves oblanceolate or oblong-lanceolate, 1 – 2½′ long, attenuate into a slender petiole, entire or repand-denticulate, the bracts much smaller but similar; spike many-flowered, becoming elongated; calyx-tube 2 – 3″ long, equalling the orbicular entire petals; capsules puberulent, 8 – 12″ long, very slender and scarcely thicker at base; seeds nearly white, very minutely pitted. — From Southern Idaho through Nevada and Utah.

Var. VILLOSA. More or less villous throughout. — Nevada.

Var. MINUTIFLORA, Watson. Flowers much reduced, scarcely more than 1″ long. — Northern Nevada and about Salt Lake, Utah.

38. Œ. BOOTHII, Dougl. With the habit of the last, but viscidly pubescent; leaves ovate, ½ – 1′ long, acuminate or acute, denticulate, shortly petioled; calyx-tube 1 – 3″ long; petals 2 – 3″ long; capsules linear-fusiform, 6 – 9″ long, 1″ broad at base and attenuate upward, much contorted; seeds brownish, angled, very minutely tuberculate, over ½″ long. — Eastern Oregon to Northern Nevada.

39. Œ. GAURÆFLORA, Torr. & Gray. Erect, often stout, ½ – 2° high, simple or branched, glabrous, or the calyx, ovary, and younger

leaves sparingly puberulent, the bark becoming white, shining and loose; leaves lanceolate or narrowly oblanceolate, acute or acuminate, narrowed to a petiole, usually denticulate; spike erect or somewhat nodding, elongated, few – many-flowered; calyx-tube and the obovate petals $1\frac{1}{2} - 3''$ long; capsule linear-fusiform, $8 - 15''$ long, subtetragonal, $1''$ wide at base, and attenuate upward to a narrow beak; seeds $1''$ long or more, linear, angled, densely cellular-pubescent under the microscope. — Southern California and Arizona.

* * Flowers yellow, turning green; calyx-tube obconic; capsules linear, tetragonal, more or less contorted; stems leafy throughout. Annual or biennial.

40. Œ. CHEIRANTHIFOLIA, Hornem. Spreading with decumbent or ascending stems, often 2° long or more, canescently pubescent; leaves thick, $\frac{1}{2} - 2\frac{1}{2}'$ (often less than $1'$) long, broadly ovate to oblong or lanceolate, the radical and lower cauline leaves spatulate or oblanceolate with a slender petiole, the upper very shortly petioled, sessile or clasping, acute or obtuse, mostly entire, sometimes obscurely denticulate; calyx-tube $1 - 1\frac{1}{2}''$ long; petals $3 - 4''$ long; capsule $4 - 8''$ long, attenuate upward, curved, subhairy; seeds ovate-oblong, $\frac{1}{2}''$ long, acute at base, smooth. — On the sea-coast, near San Francisco and southward. Like many other species, beginning to flower when very small. It is said to have come originally from Chili, and Gay mentions it as occurring in several provinces of that republic. There are no Chilian specimens in our herbariums, but the California plant accords essentially with the early figures and descriptions.

Var. SUFFRUTICOSA. (*Œ. viridescens*, Hook.) Woody at base and perhaps perennial, densely hoary-tomentose or rarely glabrous; leaves mostly small, $\frac{1}{4} - 1'$ long, crowded; flowers usually larger, the petals $4 - 9''$ long. — Sea-coast of Southern California, from Monterey to Santa Barbara.

41. Œ. BISTORTA, Nutt. Rather stout, subdecumbent or ascending, 1 – 2° high, branched from the base, simple above, somewhat hirsute, the leaves sometimes appressed-pubescent; radical leaves spatulate to lanceolate, petioled, the cauline mostly sessile, ovate to narrowly lanceolate, about $1'$ long, acute or acutish, often obtuse and clasping at base, all denticulate or dentate; calyx-tube $1 - 3''$ long; petals $4 - 7''$ long; usually with a brownish spot at base; capsules $4 - 9''$ long, acutely tetragonal, $1''$ or more wide, subattenuate at base and narrowed

above to a short beak, much contorted; seed dark, ovate-oblong, ½″ long, smooth. — San Diego.

Var. (?) VEITCHIANA, Hook. A more slender, often very reduced form; radical leaves narrowly oblanceolate and long petioled, 2 – 4′ long, the cauline often attenuate to the base; capsule more elongated and narrower, less than 1″ broad and 1 – 1½′ long, attenuate into a narrow beak at the apex, less contorted. — Southern California; Los Angeles, San Gabriel, San Diego, etc.

42. Œ. MICRANTHA, Hornem. Rather stout, erect or ascending from a decumbent base, simple or branched, becoming 1½° high, more or less hirsute; leaves narrowly lanceolate to ovate, ½ – 2′ long, the radical petioled, the cauline narrowed at base or cordate and clasping; flowers small, the calyx-tube 1″ long or less, the petals 1 – 2″ long, obovate, entire or emarginate, or sometimes 3-toothed; capsules 8 – 15″ long, acutely tetragonal, about 1″ wide at base, attenuate upward to the shortly beaked apex, usually much contorted; seeds as in the last. — Middle California, from the Sacramento to Fort Tejon.

* * * Flowers small, yellow, usually turning red; calyx-tube very short; capsule elongated, very narrowly linear, slightly curved.

43. Œ. CHAMENERIOIDES, Gray. Slender, erect, branching, 4 – 12′ high, somewhat viscidly puberulent; leaves distant, lanceolate, 1 – 2′ long, the uppermost sessile, the lower petioled, obscurely repand-denticulate; spike loose, the bracts small; calyx-tube 1″ long or less, the petals scarcely as long; capsules 1¼ – 2′ long, ½″ thick; seeds linear, ⅓″ long, white and shining. — New Mexico and Arizona.

44. Œ. DENTATA, Torr. & Gray. (Cav.?) Slender, usually diffusely branched, 1° high or less, more or less hirsute with short spreading hairs, especially towards the base, the pubescence above often shorter and somewhat glandular, or wanting; leaves linear, ½ – 1½′ long, usually narrowed at base, denticulate; petals 2 – 4″ long, rounded, entire, rarely reddening; calyx-tube broadly obconic, ½ – 1½″ long; capsule 1 – 1½′ long, sessile, attenuate above into a slender beak; seeds ⅓″ long, smooth. — From Sacramento Valley to Southern California.

This is perhaps the *Œ. dentata* of Cavanilles, though no similar Chilian specimens are in our herbariums. Plants so named, collected in Chili by Gay and Harvey, seem to be identical with the next species. Cavanilles's figure represents a simple-stemmed form with flowers and foliage nearly as in the Californian plant. The figure of Ruiz and

Pavon is yet more similar, but in both cases the stigma is figured and described as short-lobed.

Var. CRUCIATA. Petals narrowly obovate to oblong, 2″ long, often emarginate.

45. Œ. STRIGULOSA, Torr. & Gray. Nearly glabrous, the ovary and calyx usually somewhat appressed-puberulent; stems slender, ascending or erect, simple or branched, 2′ – 1° high; leaves linear or lanceolate, 3 – 9″ long, attenuate to the base, entire or sparingly denticulate; flowers very small, the petals 1 – 2″ long, usually reddening; capsule 8 – 13″ long, sessile or attenuate into a very short pedicel adnate to the petiole, scarcely attenuate above, more or less curved; seeds ⅓″ long, smooth. — From the Columbia River to San Diego, California. This includes the *Œ. parvula* and *siliquosa* of Nuttall, and probably also the *Œ. contorta* of Hooker, which is the older name, but less appropriate.

Var. PUBENS. Pubescence hirsute and spreading, as in *Œ. dentata,* especially below, often subglandular above and shorter; sometimes nearly smooth. — From Washington Territory to Southern California, and through Northern Nevada to the Wahsatch.

* * * * Low; flowers minute; capsule fusiform, short.

46. Œ. ANDINA, Nutt. But 1 – 3′ high, becoming diffusely branched, canescently puberulent throughout; leaves linear-spatulate, ½ – 1′ long, attenuate into slender petioles; spikes mostly dense, many-flowered, erect; flowers 1″ long, yellow; capsules 3 – 6″ long, attenuate upward from near the base; seeds linear-oblong, ½″ long, nearly smooth. — From Eastern Oregon to Montana, Northern Nevada, and Utah.

§ 5. CHYLISMIA, Nutt. Stigma capitate; calyx-tube funnelform or obconic; petals entire; stamens unequal, with the oblong anthers attached near the middle; capsules linear, subcylindrical or subclavate, obtuse, membranous, not sessile and usually long-pedicelled; seeds ascending in a single row in each cell. Caulescent annuals.

* Racemes loose, naked, usually few-flowered; seeds oblong-lanceolate, smooth.

47. Œ. SCAPOIDEA, Nutt. Erect, 4 – 18′ high, usually branching from near the base, puberulent or subglabrous; leaves mostly subradical, long-petioled, lyrately pinnate or sometimes undivided, the terminal leaflet much the largest, ovate to oblong-lanceolate, cuneate or cordate at base, irregularly sinuate-toothed, the prominent veins often dark-colored,

the lateral leaflets few to many or none, very irregular in shape and size; raceme at first nodding, the bracts very small or wanting; calyx-tube funnelform with a narrow base, 1 – 2″ long, the bud close and abruptly acute; petals yellow, 1 – 2″ long; capsule glabrous, 4 – 12″ long, about 1″ broad, attenuate into a pedicel which is 2 – 8″ long and ascending or divaricate; seed ½″ long. — From Western Wyoming and Southern Idaho to Southern Utah.

Var. PURPURASCENS. Usually stouter, the flowers larger and pinkish-white or purplish, rarely yellow, the tube 2 – 3″ long, the petals 3 – 4″ long. — On the eastern side of the Sierra from Oregon to Mono Lake.

Var. AURANTIACA. (*Œ. clavæformis*, Torrey.) Low, 3 – 10′ high; inflorescence puberulent; calyx-tube more or less orange; petals light rose-color or orange; capsule usually puberulent. — Southern California and Arizona.

48. Œ. BREVIPES, Gray. Like the last but usually stouter, ½ – 2° high, more or less villous with stiff hairs, not puberulent; calyx-tube obconic to funnelform, 1 – 3″ long, the segments strongly nerved and the stout tips free; petals 3 – 6″ long, apparently pale yellow or whitish; capsule 1 – 3′ long, 1¼″ broad, the pedicel 2 – 12″ long. — Southern California and Arizona.

49. Œ. CARDIOPHYLLA, Torr. Often rather slender, 3 – 10′ high, simple, erect or ascending, canescently hirsute with short spreading hairs; leaves scattered, simple, cordate or ovate, ¼ – 1¼′ long, repandly serrate, long-petioled; calyx-tube rather narrowly funnelform, 3 – 4″ long, the bud close, usually tinged with red; petals 3 – 4″ long, yellow turning to rose-color; capsule ¾ – 1½′ long, attenuate to a pedicel which is but 1 – 3″ long. — Southern California and Arizona.

50. Œ. MULTIJUGA, Watson. Glabrous or very sparingly villous, much branched above; leaves 6′ long, pinnate with many subequal leaflets 1′ long, the terminal one not larger, and with smaller ones interposed between the others, all oblong-lanceolate, acute, very irregularly and somewhat doubly sinuate-serrate, strongly veined; calyx-tube obconic, 1″ long, the bud close and obtuse; petals 4″ long, light yellow; immature capsule 9″ long, equalling the pedicel. — Southern Utah; described from a single fragmentary specimen.

* * Flowers leafy-bracted, very small; seeds oblong, deeply concave on the inner side and somewhat wing-margined, cellularly papillose.

51. Œ. PTEROSPERMA, Watson. Erect, 2 – 3′ high, simple or

branched, more or less hispid-pubescent; leaves oblong-lanceolate, 6 – 9″ long, obtuse, entire; calyx-tube very short, obconic; petals obcordate, rose-color, 1″ long; capsule cylindrical-clavate, 6 – 9″ long, attenuate at base into a spreading pedicel half as long; seeds 1″ long, the margins thin and incurved, minutely cellularly tuberculate. — Foot-hills of the Trinity Mts., Northwestern Nevada.*

§ 6. GODETIA, Spach. Stigma-lobes short, linear or roundish; calyx-tube obconic or short-funnelform; petals flabelliform, lilac-purple or rose-color; stamens unequal, the petaline filaments the shortest; anthers oblong, fixed near the base, erect or becoming arcuate; capsules ovate to linear, subcoriaceous, 4-sided; seeds horizontal, in one row, angled, vertically compressed, partially imbricated, and so the upper surface margined by a thin tuberculate crest. Annuals, simple or branching.

* Capsule ovate to oblong, sessile; stems erect, leafy, usually stout and strict, the flowers in a strict compacted spike, erect in the bud.

52. Œ. GRANDIFLORA. (*Godetia*, Lindl. *Œ. Whitneyi*, Gray.) Stem 1 – 2° high, simple or with a few short branches near the top; puberulent; leaves lanceolate, 1 – 3′ long, acute at each end or attenuate into a short petiole, obscurely repand-denticulate or entire; spike crowded; calyx-tube broadly obconical, 4 – 6″ long, the tips not free; petals 1 – 2′ long, broad, emarginate, rose-color or light purple with often a large crimson spot in the centre; stigma-lobes linear, 3″ long; capsule fusiform-oblong, 8 – 15″ long, 3 – 4″ broad, sessile or nearly so, shortly pubescent, the sides not costate; seeds ½″ long, very minutely pitted. — Humboldt and Mendocino Counties, California, on hillsides and benches.

53. Œ. PURPUREA, Curtis. Mostly very leafy, 1 – 2° high, canescently puberulent, the ovary hirsutely villous; leaves oblong to oblong-lanceolate, 1 – 3′ long, obtuse or acute, entire, sessile with an obtuse or attenuate base; flowers mostly in a leafy terminal cluster; calyx-tube

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* Œ. ARBOREA, Kellogg, from the Cerros Islands, off the coast of Lower California, is a well-marked species allied to those of this section. It is described as suffrutescent, erect and branched, 6 – 8° high, with small linear-lanceolate sessile entire villous leaves, flowers in dense erect spikes, the slender funnelform calyx-tube 1′ long (including the ovary?), the purplish petals 3″ long, capsules 3 – 12″ long, 1½″ broad, erect upon stout divaricate pedicels which are 3 – 6″ long; the seeds are linear-oblong, 1½″ long.

2 – 3″ long, the tips not free; petals 4 – 6″ long, deep purple; style shorter than the stamens, the stigma-lobes very short, purple; capsules ovate to linear-oblong, 6 – 9″ long, 2 – 2½″ broad, acute, not attenuate at base, hairy, the sides nearly flat, ribbed. — From the valley of the Columbia to Monterey, California.

54. Œ. LEPIDA, Hook. & Arn. Erect, ½ – 2° high, canescently puberulent, the stem usually white and shining; leaves oblong to oblong-lanceolate, 1 – 2′ long, usually obtuse, sessile and scarcely attenuate at base, sparingly denticulate; flowers in a short simple spike; calyx-tube 2 – 3″ long, the tips very slightly free; petals 9 – 12″ long, rose-color with a darker spot near the apex; stigmas very short, purple; capsule 5 – 8″ long, 2″ broad near the base and attenuate to the apex, hairy, the sides bicostate, at least alternately. — From the Upper Sacramento to St. Simeon (Nuttall).

Var. PARVIFLORA. (*Œ. decumbens*, Dougl.) Slender, erect or ascending, 3′ – 3° high; leaves linear to oblong, ½ – 1′ long; calyx-tube 2″ long; petals 3 – 8″ long, purple to rose-color; capsule shortly pubescent, 4 – 6″ long. — From the Columbia River to Monterey.

Var. ARNOTTII. (*Œ. Arnottii*, Torr. & Gray.) Nearly glabrous or subcanescently puberulent; leaves linear to lanceolate, 1 – 1½′ long, acute, entire or sparingly denticulate; petals 4 – 8″ long; capsules glabrous or nearly so. — California.

55. Œ. ALBESCENS. (*Godetia*, Lindl.) Simple or branching from the base, erect, 1 – 2° high, canescently puberulent; leaves linear to oblong-lanceolate, 1′ long, acutish, sparingly denticulate; flowers small, in numerous short lateral spikelets, mostly crowded into a compact spike; calyx-tube 2″ long; petals 3 – 5″ long, purplish-blue; stigmas greenish to purple; capsules oblong, 3 – 6″ long, 1½″ broad, shortly hirsute or pubescent, at least the alternate sides bicostate. — Central California.

* * Capsule linear; flowers loosely scattered in a slender spike or raceme, nodding in the bud; stems slender, less leafy.

† Capsules sessile.

56. Œ. WILLIAMSONI, Durand & Hilgard. Erect, 1° high, canescently puberulent, the calyx villous; leaves linear, 1 – 1½′ long, entire; flowers subapproximate; calyx-tube funnelform, 3 – 5″ long, the tips free; petals 6 – 12″ long, yellow at base, and with a deep purple spot

in the centre; stigma-lobes short, oblong, yellow; capsules linear-fusiform, ½′ long, tapering from above the base to the apex, furrowed over the sutures, and therefore 8-costate, puberulent. — Collected by Bridges, Heermann, and Rattan, probably on the western flank of the Sierra, from Fort Miller northward.

57. Œ. QUADRIVULNERA, Dougl. Usually very slender, erect or ascending, 1 – 2° high, puberulent; leaves linear to linear-lanceolate, 1 – 2′ long, sessile or attenuate to a short petiole, entire or slightly repand-denticulate; calyx-tube obconic, 2″ (rarely 3″) long, the tips slightly free; petals 3 – 6″ long, deep purple or purplish; stigma-lobes very short, yellow; ovary and capsule hairy, the capsule linear, 5 – 10″ long, mostly short, attenuate at the apex, scarcely so at base, the sides nearly flat, or channelled by the prominence of the sutures. — From Puget Sound to San Luis Obispo.

58. Œ. TENELLA, Cav. Erect, 6 – 18′ high, puberulent; leaves linear, ½ – 2′ long, acute or obtuse, more or less attenuate at base, mostly entire; calyx-tube shortly obconic, 1 – 3″ long, the tips close or slightly free; petals 3 – 5″ long, deep purple; stigma-lobes purple or purplish, the style shorter than the stamens; capsules puberulent, 8 – 12″ long, attenuate above but not at base, the sides nearly flat. — From Oregon to San Diego. No. 638 Brewer, from Monterey, seems to be a reduced decumbent form. The Californian plant is apparently identical with Chilian specimens collected by Gay, Bertero (469), Harvey, and Gillies.

59. Œ. VIMINEA, Dougl. Near the last. Usually stout, 1 – 3° high, branched, spreading-puberulent; leaves linear to linear-lanceolate, 1 – 2′ long, narrowed at the base, entire; calyx-tube 2 – 4″ long, the tips slightly free; petals 9 – 12″ long, deep purple or purplish; capsule 9″ long, 8-costate, smoothish. — From the Columbia River to the Sacramento, and in the mountains to the Yosemite Valley.

60. Œ. ROMANZOVII, Ledeb. Rather stout, ascending or subdecumbent, 1½° high, leafy to the top, canescently puberulent, the ovary very silky; leaves oblanceolate, 1 – 2′ long, petioled, entire or very obscurely repand-denticulate; calyx-tube very short, segments short, the tips not free in the bud; petals 6″ long, purple; filaments stout, the shorter stamens with nearly sessile anthers; stigmas not exserted beyond the calyx-tube; capsule 8 – 9″ long, attenuate at each end, sessile or slightly pedicelled, the sides channelled between the prominent sutures. — Only known from cultivated specimens, originally from seeds collected by Chamisso on the "Northwest Coast."

† † Capsules pedicelled, not costate; stigmas mostly yellow; calyx-tips not free in the bud (or very rarely in *Œ. amœna*).

61. Œ. AMŒNA, Lehm. Usually slender, erect, 1 – 2° high, minutely puberulent; leaves linear to narrowly oblanceolate, or sometimes lanceolate, 1 – 3′ long, petioled, entire or nearly so; calyx-tube obconic, 2 – 4″ long; petals 8 – 15″ long, frequently rather villous, as also the purple anthers, varying from nearly white to rose-color, with more or less of purple; filaments rather stout; stigma-lobes linear, 1½″ long, yellow; capsules 1 – 1½′ long, attenuate to a slender beak above and into the pedicel below, which is 2 – 6″ long. — From Vancouver's Island and Fraser's River to San Francisco and southward.

62. Œ. BOTTÆ, Torr. & Gray. Erect or subdecumbent at base, 1 – 1½° high, usually branched, canescently puberulent or more or less glabrous; leaves narrowly linear to lanceolate, 1 – 2′ long, on slender petioles, sparingly repand-dentate or entire; calyx-tube short; petals 6 – 12″ long, light purple; filaments usually slender, and style elongated; stigma-lobes short, yellow or purple; capsule 10 – 15″ long, attenuate at each end, the pedicel 3 – 9″ long. — Southern California, from Monterey to San Diego and Santa Barbara.

63. Œ. EPILOBIOIDES, Nutt. Erect, 1 – 3° high, tomentosely puberulent; leaves linear to linear-lanceolate, 1 – 2′ long, petioled, entire or sparingly denticulate; calyx-tube 1 – 2″ long; petals 3 – 6″ long, light purple or rose-color; stigma-lobes short; capsule 6 – 41″ long, acuminate, attenuate to a short pedicel, or rarely nearly sessile. — Apparently common, especially on the flanks of the Sierra, from Oregon to the Stanislaus River, and San Diego (Nuttall; Thurber); also in Nevada near Carson City (Anderson; Stretch). Nuttall's original specimens are small and immature, but the stigma is plainly lobed, as also appears from the description, and there can be no doubt of the identity of the species.

64. Œ. HISPIDULA. Erect, ½ – 1° high, mostly simple and often but 1-flowered, hispidly puberulent, especially above; leaves very narrowly linear, 1 – 2′ long; calyx-tube 2 – 3″ long; petals 6 – 12″ long, purple; filaments rather slender; style elongated and stigma-lobes linear; capsule 4 – 9″ long, attenuate at the apex, abruptly contracted into a pedicel 2 – 4″ long. — Sacramento and Tulare Valleys, collected by Fremont, Pratten, and Rattan.

65. Œ. BILOBA, Durand. Erect, 1° high or more (procumbent in cultivation), subcanescently and minutely puberulent; leaves nearly

glabrous, linear or narrowly lanceolate, 1 – 2′ long, obscurely repand-denticulate, the lower on long, slender petioles; calyx-tube 1 – 2″ long; petals light purple, 4 – 9″ long, cuneate-obovate, more or less deeply 2-lobed; stigmas ovate, united toward the base, apparently yellow ("purple," Durand); capsule 6 – 9″ long, puberulent, attenuate at the apex, abruptly contracted into a pedicel about 1″ long. — "Sacramento Mts." (Hartweg); Mount Bullion (Bolander); and other localities in Central California.

§ 7. BOISDUVALIA, Spach. Stigma-lobes very short, light-colored; calyx funnelform, the segments erect; petals obovate-cuneiform, 2-lobed, purple to white; filaments slender, the petaline shorter; anthers short, attached below the middle; capsule membranous, ovate-oblong to linear-cylindric, nearly terete, acute, sessile, the sides ribbed, sutures thin, dehiscent to the base; seeds ascending, few (3 – 8) in each cell, ovate-oblong, smooth; flowers small, solitary in the axils of a leafy compound or simple spike, diurnal. Annuals, erect, simple or branched.

66. Œ. DENSIFLORA, Lindl. Strict, ½ – 1° high, canescently pubescent and more or less villous; leaves lanceolate to linear-lanceolate, 1 – 3′ long, acuminate, sessile, mostly denticulate, the floral usually much shorter and broader; flowers usually in close terminal or numerous short lateral spikelets; calyx 1½ – 3″ long, the petals about twice as long; capsule ovate-oblong, 2 – 4″ long, 1½″ broad at base, attenuate upwards, smooth or slightly villous, the cells 3 – 6-seeded, the septa wholly adherent to the large placenta; seeds nearly or quite 1″ long, subplano-convex. — From Washington Territory to Monterey, and on the eastern side of the Sierra at Carson City, Nevada (Anderson). Rather variable in the form of leaves and bracts, in the character and degree of pubescence, and somewhat so in the inflorescence.

67. Œ. TORREYI. Rather slender, branched, ½ – 1½° high, villous throughout with short, stiffish, spreading hairs; leaves linear to lanceolate, 4 – 9″ long, entire or subdenticulate, usually attenuate to the base, the bracts similar and scarcely smaller; spike simple, loose; flowers very small, 1 – 2″ long, purplish; capsules linear, 4 – 6″ long, 1″ wide, acuminate, the cells 6 – 8-seeded; placenta narrow, the valves septiferous; seeds more ovate and smaller, ½″ long or less. — From Oregon (190 Hall) and Central California (Bear Mt., Borax Lake, and New Almaden, Torrey).

68. Œ. GLABELLA, Nutt. Slender, erect, 1° high, glabrous or very slightly pubescent; leaves ovate to oblong-lanceolate, $\frac{1}{2}$ – 1′ long, acute, sessile, serrate, the bracts but little smaller; spike simple; flowers shorter than the leaves, the petals less than 1″ long, deep purple; capsules 2 – 4″ long, ovate-oblong, the placenta narrow and valves septiferous; seeds 4 – 6 in each cell, linear-lanceolate, 1″ long. — From the Columbia Valley to Northern Nevada.

Doubtful Species.

Œ. PALUDOSA, Featherman, Bot. Rep. of Louisiana University, 1870, p. 74. This is probably some well-known plant; but if an *Œnothera*, the species is not recognizable from the description, which is much like Rafinesque's account of Œ. ALATA, Fl. Lud., p. 95, likewise reported from Louisiana, and not identified. The somewhat winged stems, globose stigma, habitat, etc., would indicate species of *Jussiæa*.

SYNONOMY.

55. ŒNOTHERA ALBESCENS. — No. 1730 Hartweg; 105, 107 Torrey; 273 Kellogg & Harford; Fremont.

Godetia albescens. Lindl., Bot. Reg., 27, Misc. 61; same, 28. **t. 9.**

Œ. purpurea. Bentham, Pl. Hartweg., 310.

10. ŒNOTHERA ALBICAULIS. Nuttall, "Fras. Cat."; Genera, 1. 245. James, Long's Exped., 2. 170. Torrey, Ann. N. Y. Lyc., 2. 201. Spreng., Syst., 2. 205. Hook., Fl. Bor. Am., 1. 210. Don's Mill., 2. 367. Torr. & Gray, Flora, 1. 495; Pac. R. R. Rep., 2. 164. Dietr., Syn., 2. 1287. Walpers, Repert., 2. 80; Annal., 4. 677. Torrey, Nicollet's Rep., 150; Fremont's Rep., 89 and 315; Emory's Rep., 140; Stansbury's Rep., 387; Pac. R. R. Rep., 4. 86; Bot. Mex. Bound., 65. Gray, Pl. Wright., 1. 69 and 2. 56; Pl. Thurb., 300; Pac. R. R. Rep., 12. 43; Amer. Jour. Sci., 2. 33. 405, in part, and 2. 34. 333; Proc. Amer. Acad., 8. 384. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 223. Durand, Fl. Utah, 164. Cooper, Pac. R. R. Rep., 12. 52. Engelm., Pl. Upp. Miss., 191; Amer. Jour. Sci., 2. 34. 334. Bourgeau, Palliser's Rep., 256. Porter, Hayden's Rep., 1870, 476; 1871, 483. Watson, King's Rep., 5. 106.

Œ. Nuttallii. Sweet, "Hort. Brit., 2 ed., 199."

Baumannia Nuttalliana. Spach, "Suit. Buff., 4. 352."

Anogra Nuttalliana. Spach, Monog. Onag., 20.

Var. NUTTALLII. Engelm., Amer. Jour. Sci., 2. 34. 334. Watson, King's Rep., 5. 107. — Nos. 151, 198 Nicollet; 202, 234, 751, 753 Fremont; 223 in part, 224 Fendler; 117 Parry; 408 Watson; 136 Eaton; 178 Vasey; 184 Hall; 263 Kell. & Harf.; Nuttall; Tolmie; Stansbury; Newberry; Lyall; Bourgeau; Engelmann; Howard; Canby; Meehan.

Œ. pallida. Dougl.; Lindl., Bot. Reg., 14. **t. 1142**; Hook., Fl. Bor. Am., 1.

210. Don's Mill., 2. 687. Torr. & Gray, Flora, 1. 495. Dietr., Syn., 2. 1287. Walpers, Repert., 2. 80. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 222.

Œ. leptophylla. Nutt. MS.

Baumannia Douglasiana. Spach, "Suit. Buff., 4. 352."

Anogra Douglasiana. Spach, Monog., 21.

Œ. pinnatifida, Var. *integrifolia.* Gray, Pl. Fendl., 44. Torrey, Pac. R. R. Rep., 7. 11.

Var. RUNCINATA. Engelm., l. c. — Nos. 178, 222 Fremont; 223 in part, 234 Fendler; 191, 1067 Wright; 296 Thurber; 360 Bigelow; Emory; Abert.

Œ. pinnatifida. Gray, Pl. Fendl., 43, in part; not Pursh. Torrey, Emory's Rep., 140.

Var. CALIFORNICA. — Wallace; Hutchings; Fitch; Shelton; Kell. & Harford.

Var. BREVIFOLIA. Engelm., l. c., 335. — "No. 99 Wislizenus."

Var. TRICHOCALYX. Engelm., l. c., 335. — "No. 473 Wislizenus."

37. ŒNOTHERA ALYSSOIDES. Hook. & Arn., Bot. Beech., 340. Torr. & Gray, Flora, 1. 511: Pac. R. R. Rep., 2. 121. Hook., Icones, **t. 339**. Torrey, Fremont's Rep., 315, in part. Watson, King's Rep., 5. 111. — No. 337 Fremont, in part; 151 Stretch; 99 Torrey; 420 Watson, in part; Tolmie; Beckwith; Searles; Palmer.

Sphærostigma alyssoides. Walpers, Repert., 2. 78.

Var. VILLOSA. — Stansbury; Cooper; S. H. Wright; 420 Watson, in part.

Œ. scapoidea. Torrey, Stansbury's Rep., 387, in part.

Var. *minutiflora.* Watson, King's Rep., 5. 111. — No. 421 Watson.

61. ŒNOTHERA AMŒNA. Lehmann, Ind. Sem. h. Hamb., 1821, 8; (Litt. Ber. zu Linn., 1828, 8;) Nov. Stirp., pug. 1. 23; "Nov. Act. Acad. Leop., 1828, 811, **t. 45**." Don's Mill., 2. 687. Torr. & Gray, Flora, 1. 503. Regel, Gartenflora, 13. **t. 443**. — Nos. 408, 435 Fremont; 44, 109, 132 Wilkes; 103 Torrey; 65, 135, 407 Bolander; 754 Brewer; 98 Davis; 191 Hall; 264, 272 Kell. & Harf.; Nuttall; Tolmie; Lyall; Wallace; Fitch; Suckley; Hulse; Kellogg.

Œ. roseo-alba. Hornem., "Cat. Sem. h. Erf., 1824." "Reich., Icon. Exot., **t. 47** and **150**." Sweet, Brit. Fl. Gard., **t. 268**. Seringe, DC. Prodr., 3. 48. Dietrich, Syn., 2. 1289.

Œ. Lindleyi. Dougl.; Hook., Bot. Mag., **t. 2832**. Don, Sweet's Brit. Fl. Gard., 2 ser., **t. 19**; Mill., 2. 688. Lehm., Hook. Fl. Bor. Am., 1. 211. Lindl., Bot. Reg., **t. 1405**. Hook. & Arn., Bot. Beech., 141 and 342. Torr. & Gray, Flora, 1. 502. Dietr., Syn., 2. 1287. Bentham, Bot. Sulphur, 14. C. A. Meyer, Ind. Sem. h. Petr., 11, Suppl. 58. Gray, Proc. Amer. Acad., 8. 384.

Godetia Lindleyana and *Lehmanniana.* Spach, Monog., 72.

Godetia vinosa. Lindl., Bot. Reg., 22. **t. 1880**.

Godetia rubicunda. Lindl., Bot. Reg., 22. **t. 1856**, and under t. 1880.

Œ. vinosa. Torr. & Gray, Flora, 1. 503. Dietr., Syn., 2. 1287. Torrey, Pac. R. R. Rep., 7. 11. Gray, Pac. R. R. Rep., 12. 61.

Œ. rubicunda. Hook. & Arn., Bot. Beechey, 342. Torr. & Gray, Flora, 1. 502. Dietr., Syn., 2. 1287.

Œ. macrantha. Nutt., MS.

Godetia macrantha and *amœna*. Lilja, Linnæa, 15. 265 and 17. 110.

? *Œ. arcuata*. Kellogg, Proc. Calif. Acad., 1. 58.

46. Œnothera andina. Nutt.; Torr. & Gray, Flora, 1. 512. Watson, King's Rep., 5. 112. — No. 1058 Wilkes; 425 Watson; Nuttall; Burke.

Sphærostigma andina. Walpers, Repert., 2. 79.

Œnothera arborea. Kellogg, Proc. Calif. Acad., 2. 32. Watson, above, p. 596. — Kellogg.

1. Œnothera biennis. Linn., Spec., 346. Oeder, Fl. Dan., t. 446. Aiton, Hort. Kew., 2. 2. Michx., Flora, 1. 224. Pursh, Flora, 261. Nuttall, Genera, 1. 245. Elliott, Sketch, 1. 441. James, Long's Exped., 2. 343. Torrey, Ann. N. Y. Lyc., 2. 201. Hook., Fl. Bor. Am., 1. 209; Comp. Bot. Mag., 1. 25. Hook. & Arn., Bot. Beech., 141. Torr. & Gray, Flora, 1. 492. Torrey, Nicollet's Rep., 150; Fremont's Rep., 89; Sitgreave's Rep., 159; Pac. R. R. Rep., 12. 61. Gray, Pl. Fendl., 43; Pac. R. R. Rep., 12. 43; Ives's Rep., 11; Manual, 178. Parry, Bot. Minnesota, 612. Engelm., Pl. Upp. Miss., 192. Chapman, Flora, 138. Bourgeau, Palliser's Rep., 256. Porter, Hayden's Rep., 1870, 476; 1871, 483. Watson, King's Rep., 5. 106. — Douglas; Nuttall; Scouler; Spalding; Lyall; Fremont; Bourgeau; Engelmann; 405 Watson; 267 Kell. & Harford.

Onagra biennis. Mœnch., Methodus, 675.

Œ. gauroides. Hornem., "Hort. Hafn., 362." Don's Mill., 2. 686. Seringe, DC. Prodr., 3. 52. Dietr., Syn., 2. 1286.

Onagra vulgaris and *chrysantha*. Spach, Monog., 33 and 35.

Var. grandiflora. Lindl., Bot. Reg., 19. t. 1604. Torr. & Gray, Flora, 1. 492. Ruprecht, "Bull. Acad. St. Petr., 14. 237"; (Bull. Soc. Bot. France, 3. 437.) Gray, Manual, 178. Watson, King's Rep., 5. 106. — Nos. 190, 992 Wright; 91, 294 Anderson; 406 Watson; 134 Eaton; Torrey; Parry; Stretch.

Œ. grandiflora. Aiton, Hort. Kew., 2. 2. Bartram's Travels, 406. Pursh, Flora, 261. Hook., Bot. Mag., t. 2068. Elliott, Sketch, 1. 442. Torrey, Flora U. S., 388. Don's Mill., 2. 685. Dietr., Syn., 2. 1285.

Œ. suaveolens. Desf., "Tabl., 169." Persoon, Ench., 1. 408. Poir., Suppl., 4. 141. Seringe, DC. Prodr., 3. 46. Don's Mill., 2. 685. Dietr., Syn., 2. 1285.

Œ. Lamarckiana. Seringe, DC. Prodr., 3. 46. Don's Mill., 2. 685. Dietr., Syn., 2. 1285.

Var. hirsutissima. Gray, Pl. Fendl., 43; Pl. Wright., 1. 69 and 2. 56. Torrey, Bot. Mex. Bound, 65. — No. 218 Fendler; 1066 Wright; 735 Thurber; 105, 712 Brewer; 27 Xantus; 268 Kell. & Harf.; Emory; Abert; Bolander; Kern; Sanderson.

Œ. odorata ? Hook. & Arn., Bot. Beech., 343.

Œ. Hookeri. Torr. & Gray, Flora, 1. 493. Walpers, Repert., 2. 81.

Œ. biennis. Torrey, Emory's Rep., 140; Bot. Mex. Bound., 65. Gray, Pl. Xantus in Proc. Bost. Soc. Nat. Hist., 7. 146.

Var. cruciata. Torr. & Gray, Flora, 1. 492. Gray, Manual, 178.

Œ. cruciata. Nuttall, MS. Don's Mill., 2. 686.

Var. canescens. Torr. & Gray, Flora, 1. 492. Gray, Pl. Fendl., 43. Newberry, Pac. R. R. Rep., 6. 74.

? *Œ. pubescens*. Nees, Pl. Maxim. v. Wied, 9; not Willd.

Var. OAKESIANA. Gray, Manual, 178.

Œ. Oakesiana. Robbins, MS.

Var. MURICATA. Torr. & Gray, Flora, 1. 492. Gray, Manual, 178.

Œ. muricata. Linn., Syst., 12 ed., 296. Murr., "Comm. Gött., 6. 24, t. 1." Ait., Hort. Kew., 2 ed., 2. 341. Pursh, Flora, 261. Elliott, Sketch, 1. 441. Hornem., Fl. Dan., 10. t. 1752. Torrey, Flora U. S., 388. Seringe, DC. Prodr., 3. 46. Don's Mill., 2. 685. Ruprecht, "Bull. Acad. St. Petr., 14. 237"; (Bull. Soc. Bot. France, 3. 437.)

Onagra muricata. Moench., Methodus, 675.

Var. PARVIFLORA. Torr. & Gray, Flora, 1. 492. Gray, Manual, 178.

Œ. parviflora. Linn., Spec., 2 ed., 1. 492. Aiton, Hort. Kew., 2. 2. Lam., Dict., 4. 551. Persoon, Ench., 1. 408. Pursh, Flora, 261. Torrey, Flora U. S., 388. Seringe, DC. Prodr., 3. 47. Don's Mill., 2. 685. Dietr., Syn., 2. 1286.

65. ŒNOTHERA BILOBA. Durand, Pl. Pratten., 87. Torrey, Pac. R. R. Rep., 4. 86. — No. 1728 Hartweg; 109, 109 a Bridges; 6364 Bolander; Fremont; Fitch; Anderson; Gray.

Œ. tenella, Var. *tenuifolia.* Bentham, Pl. Hartw., 310.

41. ŒNOTHERA BISTORTA. Nuttall; Torr. & Gray, Flora, 1. 508. Torrey, Pac. R. R. Rep., 7. 11; Bot. Mex. Bound., 66. — No. 602 Thurber; 261 Kell. & Harf., in part; Nuttall; Newberry; Cooper.

? *Holostigma Bottæ.* Spach, Monog., 16.

Œ. heterophylla, Nutt. MS.; not Spach.

Sphærostigma bistorta. Walpers, Repert., 2. 77.

Œ. cheiranthifolia. Gray, Ives's Rep., 12.

Var. (?) VEITCHIANA. Hook., Bot. Mag., t. 5078. — Nuttall; Bigelow; Davidson; Wallace; Cooper.

Œ. graciliflora. Torrey, Pac. R. R. Rep., 4. 87; not Hook. & Arn.

38. ŒNOTHERA BOOTHII. Dougl.; Hook., Fl. Bor. Am., 1. 213. Don's Mill., 2. 84. Spach, Monog., 16. Torr. & Gray, Flora, 1. 509. Dietr., Syn., 2. 1285. Watson, King's Rep., 5. 110. — No. 419 Watson; Douglas; Nuttall; Bailey.

Œ. pygmæa. Dougl.; Hook., Fl. Bor. Am., 1. 213. Don's Mill., 2. 685. Spach, Monog., 16. Dietr., Syn., 2. 1285.

Œ. lithospermoides. Nutt., MS.

Sphærostigma Boothii. Walpers, Repert., 2. 77.

62. ŒNOTHERA BOTTÆ. Torr. & Gray, Flora, 1. 505. Dietr., Syn., 2. 1285. — No. 1729 Hartweg; 108 Bridges; 29, 29 a Xantus; 110 Torrey; 701 Brewer; Botta; Woodhouse; Parry; Wallace.

Godetia Bottæ. Spach, Monog., 73.

Œ. Californica. Dietr., Syn., 2. 1288.

Œ. rubicunda. Bentham, Pl. Hartw., 310. Gray, Pl. Xant., in Proc. Bost. Soc., 7. 146.

Œ. tenella. Gray, l. c.

22. Œ. BRACHYCARPA. Gray, Pl. Wright., 1. 70 and 2. 57; Proc. Amer. Acad., 8. 384. Torrey, Bot. Mex. Bound., 65. Walpers, Annal., 4. 676. — No. 1073 Wright; 364 Bigelow; ? [412 Watson; Pope; Henry; Howard.]

? *Œ. marginata*, Var. *purpurea*. Watson, King's Rep., 5. 108. Porter, Hayden's Rep., 1871, 483.

? *Œ. Wrightii*, q. v.

28. ŒNOTHERA BREVIFLORA. Torr. & Gray, Flora, 1. 506. Walpers, Repert., 2. 85. Watson, King's Rep., 5. 109. — No. 176 Hall & Harb.; 416 Watson; Nuttall; Fremont.

Taraxia breviflora. Nutt., MS.

Œ. Nuttallii. Torrey, Fremont's Rep., 89. Gray, Proc. Acad. Phil., 1863, 61.

48. ŒNOTHERA BREVIPES. Gray, Pac. R. R. Rep., 4. 87; Ives's Rep., 12. — No. 180 Coulter, in part; Newberry; Bigelow; Schott; Almendinger; Cooper.

Œ. clavæformis. Torrey, Bot. Mex. Bound., 66, in part.

19. ŒNOTHERA CÆSPITOSA. Nutt., "Fraser, Cat."; Genera, 1. 246. Sims, Bot. Mag., **t. 1593**. Pursh, Flora, 735. Seringe, DC. Prodr., 3. 46. Don's Mill., 2. 687. Torr. & Gray, Flora, 1. 500. Dietr., Syn., 2. 1287. Torrey, Nicollet's Rep., 150; Stansbury's Rep., 387. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 223. Gray, Pac. R. R. Rep., 12. 43; Proc. Amer. Acad., 8. 384. Engelm., Pl. Upp. Miss., 191. Durand, Fl. Utah, 164. Porter, Hayden's Rep., 1870, 476. — No. 560 Fremont; 228 Fendler; 290 Thurber; 173 Hall & Harb.; 74, 292 Anderson; 242 Stretch; 411 Watson; 138 Eaton; 176 Vasey; Nuttall; Nicollet; Beckwith; Stansbury; Parry; Hill; Canby; Kell. & Harford.

Œ. scapigera. Pursh, Flora, 263. Link, Enum., 1. 377.

Pachylophis Nuttallii. Spach, Monog., 36, **t. 30, fig. 1**.

Œ. montana. Nutt.; Torr. & Gray, Flora, 1. 500. Walpers, Repert., 2. 83. Torrey, Fremont's Rep., 315; Stansbury's Rep., 387. Gray, Pl. Fendl., 45. Engelm., Pl. Upp. Miss., 191.

Œ. marginata. Nutt.; Hook. & Arn., Bot. Beech., 342. Torr. & Gray Flora, 1. 500; Pac. R. R. Rep., 2. 120. Walpers, Repert., 2. 83. Torrey, Stansbury's Rep., 387; Bot. Mex. Bound., 65. Gray, Proc. Acad. Phil., 1863, 61. Hook. f., Bot. Mag., **t. 5828**. Porter, Hayden's Rep., 1871, 483. Watson, King's Rep., 5. 108.

Œ. eximia. Gray, Pl. Fendl., 45; Ives's Rep., 11. Walpers, Annal., 2. 533.

24. ŒNOTHERA CANESCENS. Torrey, Fremont's Rep., 315; (Bot. Zeit., 5. 44.) Gray, Pl. Fendl., 44; Pl. Wright., 1. 70. Walpers, Annal., 1. 292. — No. 192 Fremont; 227 Fendler; Wislizenus; Newberry.

Œ. guttulata. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 222.

49. ŒNOTHERA CARDIOPHYLLA. Torrey, Pac. R. R. Rep., 5. 360; Bot. Mex. Bound., 66. — Schott; Thomas; Du Barry; Palmer.

43. ŒNOTHERA CHAMÆNERIOIDES. Gray, Pl. Wright., 2. 58; Pl. Thurb., 298; Ives's Rep., 12. Walpers, Annal., 4. 677. Torrey, Bot. Mex. Bound., 66. — Nos. 38, 1377 Wright; 373 Bigelow; 174 Thurber; Parry; Palmer.

40. ŒNOTHERA CHEIRANTHIFOLIA. Hornem., "Hort. Hafn." Sprengel, Syst., 2. 228. Lindl., Bot. Reg., 12. **t. 1040**. Seringe, DC. Prodr., 3. 46. Don's Mill., 2. 684. Torr. & Gray, Flora, 1. 509. Dietr., Syn., 2. 1284. Bentham, Bot. Sulph., 15. Torrey, Pac. R. R. Rep., 7. 11. — No. 104 Bridges; 108 Torrey; 93 Bolander; Douglas; Rich.

Œ. spiralis. Hook., Fl. Bor. Am., 1. 214. Don's Mill., 2. 685. Spach, Monog., 16. Hook. & Arn., Bot. Beech., 141 and 341. Dietr., Syn., 2. 1285.

Holostigma cheiranthifolium. Spach, Monog., 15.

Sphærostigma cheiranthifolium. Fisch. & Meyer, Ind. Sem. h. Petr., 2. 25; (Litt. Ber. zu Linnæa, 1837, 120.) Gay, Fl. Chil., 2. 330.

Sphærostigma spirale. Fisch. & Meyer, l. c.

Œ. viridescens. Torrey, Pac. R. R. Rep., 4. 87.

Œ. contorta. Bolander, Catalogue, 12.

Var. SUFFRUTICOSA. — No. 153 Coulter; 250, 307 Brewer; Nuttall; Wallace; Rich.

Œ. viridescens. Hook., Fl. Bor. Am., 1. 214. Don's Mill., 2. 685. Spach, Monog., 16. Torr. & Gray, Flora, 1. 508. Bolander, Cat., 12.

Œ. maritima. Nutt., MS.

Sphærostigma viridescens. Walpers, Repert., 2. 77.

11. ŒNOTHERA CORONOPIFOLIA. Torr. & Gray, Flora, 1. 495. Walpers, Repert., 2. 80. Gray, Pl. Fendl., 43; Pl. Wright., 2. 57; Pac. R. R. Rep., 12. 43; Amer. Jour. Sci., 2. 34. 333; Proc. Acad. Phil., 1863, 61. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 222. Torrey, Sitgreave's Rep., 159; Pac. R. R. Rep., 4. 86 and 7. 11; Bot. Mex. Bound., 65. Engelm., Pl. Upp. Miss., 191; Amer. Jour. Sci., 2. 34. 333. Porter, Hayden's Rep., 1870, 476. Watson, King's Rep., 5. 106. — Nos. 222, 225 Fendler; 178 Hall & Harb.; 407 Watson; 135 Eaton; 180, 181 Vasey; James; Nuttall; Abert; Engelmann; Kern; Meehan; Gray.

Œ. pinnatifida. James, Long's Exped., 2. 154; not Nuttall. Torrey, Ann. N. Y. Lyc., 2. 201.

66. ŒNOTHERA DENSIFLORA. Lindl., Bot. Reg., 19. **t. 1593**; (Litt. Ber. zu Linnæa, 1835, 15.) Torr. & Gray, Flora, 1. 505. Hook., Pl. Geyer in Lond. Jour. Bot., 6. 224. Torrey, Pac. R. R. Rep., 4. 86. Newberry, Pac. R. R. Rep., 6. 74. Bolander, Cat., 12. Gray, Proc. Amer. Acad., 8. 384, excl. vars. — No. 591 Geyer; 104 Torrey, in part; 26, 54, 118 Anderson; 811 Brewer; 185–188 Hall; Douglas; Lyall; Spalding; Gibbons; Bigelow; Fitch.

Boisduvalia Douglasii. Spach, Monog., 80, **t. 31, fig. 2.**

Œ. salicifolia and *imbricata.* Nutt., MS.

44. ŒNOTHERA DENTATA. Cav., Icon., 4. 67, **t. 398.** Ruiz & Pav., Fl. Peruv., 3. 81, **t. 317.** Seringe, DC. Prodr., 3. 46. Presl, Rel. Hænke, 2. 31. Torr. & Gray, Flora, 1. 511. Dietr., Syn., 2. 1284. Torrey, Pac. R. R. Rep., 4. 87. Gray, Ives's Rep., 12. — Nos. 166, 172 Fremont; 106 Bridges; 4844 Bolander; 262 Kell. & Harf.; Douglas; Bigelow; Parry; Wallace; Heermann.

Holostigma argutum. Spach, Monog., 13.

Sphærostigma dentatum. Walpers, Repert., 2. 78. Gay, Fl. Chil., 2. 326.

Var. CRUCIATA. — No. 1733 Hartweg; Stillman; Shelton; Fitch.

Œ. strigulosa. Bentham, Pl. Hartw., 310; not Torr. & Gray.

6. ŒNOTHERA DRUMMONDII. Hook., Bot. Mag., **t. 3361**; (Ann. Sci. Nat., 2. 5. 296.) Spach, Monog., 28. Torr. & Gray, Flora, 1. 493. Dietr., Syn., 2. 1290. Walpers, Repert., 2. 81. Torrey, Fremont's Rep., 89. Gray, Pl. Lindh., 8 and 189. Scheele, Roemer's Texas, 430. — No. 80 Drummond; 53 Lindheimer; 99 Schott; ? 53 Xantus; Berlandier.

? *Œ. sinuata*, Var. *humifusa*. Gray, Proc. Amer. Acad., 5. 158.

63. ŒNOTHERA EPILOBIOIDES. Nutt.; Torr. & Gray, Flora, 1. 511. Walpers, Repert., 2. 78. — No. 534 Thurber; 45 Beckwith; 108 a Bridges; 252 Anderson; 272 Stretch; 6366 Bolander; 192 Hall; Nuttall; Bigelow; Gray; Kell. & Harford.

Œ. rubicunda. Torrey, Pac. R. R. Rep., 2. 121.

Œ. tenella, Var. *tenuifolia*. Torrey, Pac. R. R. Rep., 4. 86.

Œ. vinosa. Torrey, Bot. Mex. Bound., 66.

Œ. viminea. Watson, King's Rep., 5. 108.

Œ. tenella. Gray, Proc. Amer. Acad., 8. 384.

25. ŒNOTHERA FREMONTII. — No. 363 Bigelow; Fremont; Parry.

Œ. Wrightii. Torrey, Bot. Mex. Bound., 65, in part.

15. ŒNOTHERA FRUTICOSA. Linn., Spec., 346. Ait., Hort. Kew., 2. 4. Pursh, Flora, 262. Nutt., Genera, 1. 247. Elliott, Sketch, 1. 442. Torrey, Flora U. S., 389; Flora N. York, 1. 234. Hook., Fl. Bor. Amer., 1. 212; Bot. Mag., under t. 3548, in part. Torr. & Gray, Flora, 1. 496. Chapman, Flora, 139. Gray, Manual, 179.

Œ. mollissima. Walter, Fl. Car., 129; not Linn.

Œ. tetragona. Roth, Cat. Bot., 2. 39; Beiträg. Bot., 1. 200; Ann. Bot., 2. 30. Seringe, DC. Prodr., 3. 52. Don's Mill., 2. 691.

Œ. hybrida. Michx., Flora, 1. 225. Pursh, Flora, 262. Elliott, Sketch, 1. 442. Seringe, DC. Prodr., 3. 50. Dietr., Syn., 2. 1288.

Kneiffia suffruticosa and *floribunda*. Spach, Monog., 45 and 46.

Var. LINEARIFOLIA. Hook., Bot. Mag., under t. 3545. — No. 78 Drummond; 54 Lindheimer; 126 Palmer; 210 Hall; Nuttall; Wright; Pitcher; Leavenworth.

Œ. linearis. Michx., Flora, 1. 225. Pursh, Flora, 262. Nutt., Genera, 1. 248. Elliott, Sketch, 1. 444. Seringe, DC. Prodr., 3. 51. Torr. & Gray, Flora, 1. 497. Chapman, Flora, 139. Gray, Manual, 179, in part.

? *Œ. media*. Link, Enum. Berol., 1. 377. Seringe, DC. Prodr., 3. 49. Dietr., Syn., 2. 1286.

Œ. riparia. Nutt., Genera, 1. 247. Seringe, DC. Prodr., 3. 52. Torr. & Gray, Flora, 1. 497. Chapman, Flora, 139. Gray, Manual, 179.

Kneiffia angustifolia and ? *maculata*. Spach, Monog., 46 and 47.

Onagra Linkiana. Spach, Monog., 34.

Var. HUMIFUSA. Allen, Bull. Torr. Bot. Club, 1. 2.

Œ. linearis, var. Torr. & Gray, Flora, 1. 497.

Œ. linearis. Gray, Manual, 179, in part.

Var. AMBIGUA. Nutt., Genera, 1. 247. Torrey, Flora U. S., 389. Hook., Bot. Mag., t. 3545. Torr. & Gray, Flora, 1. 496.

Œ. ambigua. Spreng., Syst., 2. 229. Seringe, DC. Prodr., 3. 50. Dietr., Syn., 2. 1289.

Œ. Canadensis. Goldie, "Edinb. Phil. Jour., 1822." Seringe, DC. Prodr., 3. 52.

Var. PHYLLOPUS. Hook., Fl. Bor. Am., 1. 212. Torr. & Gray, Flora, 1. 496.

Œ. fruticosa. Sims, Bot. Mag., t. 332.

Œ. serotina. Don; Sweet's Brit. Fl. Gard., **t. 184**. Sweet, "Hort. Brit., **t. 152**." Lindl., Bot. Reg., 22. **t. 1840**. Don's Mill., 2. 689.

Var. INCANA. Hook., Fl. Bor. Am., 1. 212. Torr. & Gray, Flora, 1. 496.

Œ. incana. Nutt., Genera, 1. 247. Torrey, Flora U. S., 389. Spreng., Syst., 2. 229. Seringe, DC. Prodr., 3. 52. Don's Mill., 2. 690.

Var. HIRSUTA. Nutt.; Torr. & Gray, Flora, 1. 496.

Œ. pilosella. Raf., Ann. Nat., 15.

39. ŒNOTHERA GAURÆFLORA. Torr. & Gray, Flora, 1. 510. Torr., Bot. Mex. Bound., 66. Gray, Ives's Rep., 12. — No. 337 Fremont, in part; 273 a Schott; 579, 1218 Brewer; Douglas; Newberry; Cooper; Andrews.

Gaura decorticans. Hook. & Arn., Bot. Beech., 343.

Sphærostigma gauræflora. Walpers, Repert., 2. 78.

Œ. Nevadensis. Kellogg, Proc. Acad. Calif., 2. 224, **fig. 70**.

68. ŒNOTHERA GLABELLA. Nutt.; Torr. & Gray, Flora, 1. 505. Watson, King's Rep., 5. 108. Gray, Proc. Amer. Acad., 8. 384. — No. 413 Watson; 190 Hall; Nuttall.

16. ŒNOTHERA GLAUCA. Michx., Flora, 1. 224. Pursh; Sims, Bot. Mag., **t. 1606**; Flora, 262. Nutt., Genera, 1. 247. Seringe, DC. Prodr., 3. 50. Lindl., Bot. Reg., 18. **t. 1511**. Torr. & Gray, Flora, 1. 497. Chapman, Flora, 138. Gray, Manual, 179.

Kneiffia glauca. Spach, Monog., 45.

Var. FRASERI. Torr. & Gray, Flora, 1. 497.

Œ. Fraseri. Pursh; Sims, Bot. Mag., **t. 1674**; Flora, 2. 734. Elliott, Sketch, 1. 443. Seringe, DC. Prodr., 3. 51. Dietr., Syn., 2. 1289.

Kneiffia Fraseri. Spach, Monog., 46.

Œ. fruticosa, Var. *Fraseri.* Hook., Bot. Mag., under t. 3548.

32. ŒNOTHERA GRACILIFLORA. Hook. & Arn., Bot. Beech., 341. Torr. & Gray, Flora, 1. 507. Hook., Icones, **t. 338**. Walpers, Repert., 2. 86. Bentham, Pl. Hartw., 310. Bolander, Cat., 12. — No. 173 Coulter; 1732 Hartweg; 218 Fremont; 1109 Brewer; 4564, and c. Bolander; 259 Kell. & Harf.; Douglas; Stillman; Rich.

52. ŒNOTHERA GRANDIFLORA. — No. 6534 Bolander; 274 Kell. & Harford.

Godetia grandiflora. Lindl., Bot. Reg., 27, Misc., 61, and 28. **t. 61**; not Aiton.

Œ. Whitneyi. Gray, Proc. Amer. Acad., 7. 340 and 400. Hook. f., Bot. Mag., **t. 5867**. Bolander, Cat., 12.

34. ŒNOTHERA GREGGII. Gray, Pl. Fendl., 46; Pl. Wright., 1. 72. Walpers, Annal., 2. 533. — No. 199 Wright; 30 Gordon; Gregg.

Œ. Lampasana. Buckley, Proc. Phil. Acad., 1861, 454.

Œ. Hartwegi, var. Gray, Proc. Phil. Acad., 1862, 163.

33. ŒNOTHERA HARTWEGI. Bentham, Pl. Hartw., 5. Gray, Pl. Fendl., 46; Pl. Wright., 1. 72 and 2. 58. Torrey, Sitgreave's Rep., 159; Bot. Mex. Bound., 66. — No. 10 Hartweg; 33, 303 Gregg; 196, 198, 1075, 1093 Wright; 123 Thurber; 369 Parry; 27 Edwards & Eaton; Schott.

Var. LAVANDULÆFOLIA. — No. 1074 Wright; 16 Geyer; 368 Bigelow; 77, 115 Parry; 62 Hall; James; Nuttall; Gregg; Engelmann.

Œ. insignis. Nutt., MS.

Œ. lavandulæfolia. Torr. & Gray, Flora, 1. 501; Pac. R. R. Rep., 2. 164. Walpers, Repert., 2. 85. Gray, Pl. Fendl., 46; Pl. Wright., 1. 72 and 2. 58; Amer. Jour. Sci., 2. 33. 405. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 223. Torrey, Marcy's Rep., 285; Bot. Mex. Bound., 66. Engelm., Pl. Upp. Miss., 192.

Var. FENDLERI. Gray, Pl. Wright., 1. 72 and 2. 58; Pl. Thurb., 300. Torr. & Gray, Pac. R. R. Rep., 2. 164. — No. 230 Fendler; 1076 Wright; 265 Thurber; 130 Palmer; Smith.

Œ. Fendleri. Gray, Pl. Fendl., 45. Walpers, Annal., 2. 533.

30. ŒNOTHERA HETERANTHA. Nuttall, Journ. Acad. Phil., 7. 22. Torr. & Gray, Flora, 1. 507. Walpers, Repert., 2. 86. Gray, Pl. Fendl., 45; Pl. Wright., 1. 70. Watson, King's Rep., 5. 110. Porter, Hayden's Rep., 1871, 483. — No. 406 Geyer; 418 Watson, in part; 139 Eaton; Wyeth.

Jussiæa subacaulis. Pursh, Flora, 1. 304.

Œ. triloba. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 223; not Nuttall.

Var. (?) TARAXACIFOLIA. — No. 418 Watson, in part.

3. ŒNOTHERA HETEROPHYLLA. — Spach, Monog., 28. Walpers, Repert., 2. 81. — No. 74 Drummond; 1842 Berlandier; 56 Lindheimer; 201 Hall; Wright; Linsecum; Buckley.

Œ. bifrons. Don, Sweet's Brit. Fl. Gard., 2 ser., t. 386. Hook., Bot. Mag., t. 3764. Torr. & Gray, Flora, 1. 492. Dietr., Syn., 2. 1290. Walpers, Repert., 2. 81. Gray, Pl. Wright., 1. 69; Proc. Acad. Phil., 1862, 163; Hall's Pl. Tex., 9.

Œ. rhombipetala. Engelm. & Gray, Pl. Lindh., 8. Dur. & Hilg., Pac. R. R. Rep., 5. 7.

Œ. Leona. Buckley, Proc. Acad. Phil., 1861, 163.

64. ŒNOTHERA HISPIDULA. — No. 307, and Ppp., Fremont; 32 Rattan; Pratten.

Œ. rubicunda. Durand, Pl. Pratten., 87.

5. ŒNOTHERA HUMIFUSA. Nutt., Genera, 1. 245. Spreng., Syst., 2. 228. Seringe, DC. Prodr., 3. 47. Don's Mill., 2. 687. Spach, Monog., 30.

Œ. sinuata, Var. *humifusa.* Torr. & Gray, Flora, 1. 494. Chapman, Flora, 138.

2. ŒNOTHERA JAMESII. Torr. & Gray, Flora, 1. 493. Walpers, Repert., 2. 81. Gray, Pl. Lindh., 189; Pl. Wright., 1. 69. Torrey, Sitgreave's Rep., 175; Pac. R. R. Rep., 4. 86; Bot. Mex. Bound., 65. — No. 375 and 502 Lindheimer; 189 Wright; 63 Thurber; 357 Parry; James.

54. ŒNOTHERA LEPIDA. Hook. & Arn., Bot. Beech., 342. Torr. & Gray, Flora, 1. 504. Dietr., Syn., 2. 1287. Bentham, Pl. Hartw., 310. Torrey, Pac. R. R. Rep., 4. 86. Gray, Pac. R. R. Rep., 12. 61. — No. 1727 Hartweg; 282 Bolander, in part; 690 Brewer; Nuttall; Bigelow; Pratten; Hulse.

Godetia lepida. Lindl., Bot. Reg., 22. t. 1849.

Œ. purpurea. Durand, Pl. Pratten., 88, in part.

Var. PARVIFLORA. — Nos. 441, 484 Fremont; 194 Hall, and 188, in part; 266, 269 Kell. & Harf.; Douglas; Tolmie; Shelton; Fitch; Bigelow; Willey.

Œ. decumbens. Dougl.; Hook., Bot. Mag., **t. 2889.** Lindl., Bot. Reg., 15. **t. 1221.** Lehm., Hook. Fl. Bor. Am., 1. 211. Don's Mill., 2. 688. Torr. & Gray, Flora, 1. 504. Dietr., Syn., 2. 1287. Durand, Pl. Pratten., 87.

Godetia decumbens. Spach, Monog., 68, **t. 30, fig. 2.**

Œ. viminea. Torrey, Pac. R. R. Rep., 4. 86, in part.

Œ. densiflora, var. Gray, Proc. Amer. Acad., 8. 384, in part.

Var. ARNOTTII. — No. 104 Torrey, in part; 193 Hall, in part; Douglas; Bolander.

Œ. viminea, var. Hook. & Arn., Bot. Beech., 342.

Œ. Arnottii. Torr. & Gray, Flora, 1. 503.

12. ŒNOTHERA LINIFOLIA. Nuttall, Journ. Acad. Phil., 2. 120; (Litt. Ber. zu Linnæa, 1829, 40.) Seringe, DC. Prodr., 3. 50. Don's Mill., 2. 691. Torr. & Gray, Flora, 1. 499. Dietr., Syn., 2. 1288. Engelm. & Gray, Pl. Lindh., 8. Chapman, Flora, 139. Gray, Hall's Pl. Texan., 9. — No. 78 Drummond; 54 Lindheimer; 210 Hall; Wright; Leavenworth.

Kneiffia linifolia. Spach, Monog., 48.

27. ŒNOTHERA MACROSCELES. Gray, Pl. Fendl., 43. Walpers, Annal., 2. 533. — Gregg.

42. ŒNOTHERA MICRANTHA. Hornem., "Hort. Hafn." Spreng., Syst., 2. 228. Hook. & Arn., Bot. Beech., 341. Torr. & Gray, Flora, 1. 509. — Nos. 155, 221, 282, 320, 324, 391, 443, 446, 988, 1137 Brewer; 6363, 6420 Bolander; 28 Xantus; 261 Kell. & Harf., in part; Douglas; Nuttall; Fremont; Wallace; Gibbons; Torrey.

Œ. dentata. Seringe, DC. Prodr., 3. 46, in part; not Cav.

Œ. hirta. Link, "Enum., 1. 378." Don's Mill., 2. 684.

Sphærostigma hirtum. Fisch. & Mey., Ind. Sem. h. Petr., 2. 25; (Litt. Ber. zu Linnæa, 1837, 120.)

Holostigma micranthum. Spach, Monog., 15.

Sphærostigma micranthum. Walpers, Repert., 2. 77.

Œ. asperifolia. Nutt., MS.

Œ. cheiranthifolia. Torrey, Pac. R. R. Rep., 4. 87.

Œ. strigulosa. Torrey, Pac. R. R. Rep., 4. 87, in part.

Œ. bistorta. Gray, Pl. Xantus in Proc. Bost. Soc., 7. 146.

26. ŒNOTHERA MISSOURIENSIS. Sims, Bot. Mag., **t. 1592,** and under t. 1674. Don's Mill., 2. 689. Torr. & Gray, Flora, 1. 500; Pac. R. R. Rep., 2. 164. Torrey, Fremont's Rep., 89 and 315; Pac. R. R. Rep., 4. 86; Bot. Mex. Bound., 65, in part. Gray, Pl. Lindh., 188; Pl. Wright., 1. 70; Proc. Acad. Phil., 1863, 61; Hall's Pl. Tex., 9. Engelm., Wislizenus's Report, 3. Wood, Classbook, 353. — Nos. 81, 108 Fremont; 43 Fendler; 255, 391 Lindheimer; 194 Wright; 362 Bigelow; 31 Gordon; 174 Hall & Harb.; 131 Palmer; 207 Hall; James; Gleason; Greene.

Megapterium Missouriense. Spach, Monog., 31.

Œ. Drummondii. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 221.

Var. LATIFOLIUM. Gray, Pl. Lindh., 188.

Œ. macrocarpa. Pursh, Flora, 734. James, Long's Exped., 2. 324. Torrey, Ann. N. Y. Lyc., 2. 201. Sweet, Brit. Fl. Gard., **t. 5.** Spreng., Syst., 2.

229. Seringe, DC. Prod., 3. 47. Don's Mill., 2. 689. Dietr., Syn., 2. 1286. Scheele, Römer's Texas, 430.

Œ. alata. Nutt., Genera, 1. 248.

Megapterium Nuttallii. Spach, Monog., 31.

Var. INCANA. Gray, Pl. Lindh., 189. Torrey, Pac. R. R. Rep., 4. 86.

50. ŒNOTHERA MULTIJUGA. Watson, Amer. Naturalist, 7. 300. — Thompson.

29. ŒNOTHERA NUTTALLII. Torr. & Gray, Flora, 1. 506. Walpers, Repert., 2. 86. Watson, King's Rep., 5. 110. — No. 43 Beckwith; 417 Watson; Nuttall; Newberry; Cronkhite; Lyall; Anderson; Stretch; Bolander & Kellogg.

Taraxia longifolia. Nutt., MS.

Œ. tanacetifolia. Torr. & Gray, Pac. R. R. Rep., 2. 121, t. 4; (Nuremberg Flora, 41. 622.) Newberry, Pac. R. R. Rep., 6. 74. Watson, King's Rep., 5. 110.

31. ŒNOTHERA OVATA. Nutt.; Torr. & Gray, Flora, 1. 507. Walpers, Repert., 2. 86. Bentham, Pl. Hartw., 310. Torrey, Pac. R. R. Rep., 4. 87. Bolander, Cat., 12. — No. 125 Fremont; 1731 Hartw.; 902 Brewer; 260 Kell. & Harf.; d. Bolander; Nuttall; Bigelow; Bloomer.

8. ŒNOTHERA PINNATIFIDA. Nutt., Genera, 1. 245. Spreng., Syst., 2. 229. Torr. & Gray, Flora, 1. 494. Dietr., Syn., 2. 1289. Walpers, Repert., 2. 79. Torrey, Nicollet's Rep., 150. Nees, Pl. Maxim., 9. Gray, Pl. Fendl., 43; Amer. Jour. Sci., 2. 34. 333; Proc. Phil. Acad., 1863, 61. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 221. Engelm., Pl. Upp. Miss., 191; Amer. Jour. Sci., 2. 34. 333. Porter, Hayden's Rep., 1870, 476. — Nos. 46, 267 Fremont; 223 Fendler; 201 Nicollet; 1069, 1070 Wright; 279 Thurber; 359 Bigelow; 116 Parry; 177 Hall & Harb.; 179 Vasey; 121 Greene; Bradbury; Nuttall; Newberry; Schott; Kern; Smith; Henry; Howard; Gray; and others.

Œ. albicaulis. Pursh, Flora, 733; not Nuttall. Seringe, DC. Prodr., 3. 51. Torrey, Bot. Mex. Bound., 65. Gray, Ives's Rep., 11; Amer. Jour. Sci., 2. 33. 405, in part.

Œ. Bradburiensis. Nutt., MS.

Œ. Purshiana. Steud., Nomenclator, 2. 207.

Œ. Purshii. Don's Mill., 2. 688.

Œ. coronopifolia. Gray, Pl. Wright., 2. 56; not Torr. & Gray.

20. ŒNOTHERA PRIMIVERIS. Gray, Pl. Wright., 2. 58; Pl. Thurb., 298; Ives's Rep., 11. Walpers, Annal., 4. 677. Torrey, Bot. Mex. Bound., 65. — No. 1376 Wright.; 366 Parry; Newberry.

51. ŒNOTHERA PTEROSPERMA. Watson, King's Rep., 5. 112, t. 14. — No. 424 Watson.

14. ŒNOTHERA PUMILA. Linn., Spec., 2 ed., 493. Aiton, Hort. Kew., 2. 4. Curtis, Bot. Mag., t. 355. Pursh, Flora, 262. Elliott, Sketch, 1. 444. Hook., Fl. Bor. Am., 1. 212. Torr. & Gray, Flora, 1. 498. Chapman, Flora, 139. Bourgeau, Palliser's Rep., 256. Gray, Manual, 179. — Bourgeau.

Œ. pusilla. Michx., Flora, 1. 225. Pursh, Flora, 263. Nutt., Genera, 1. 248. Torrey, Flora U. S., 390. Seringe, DC. Prodr., 3. 51. Don's Mill., 2. 690.

Œ. chrysantha. Michx., Flora, 1. 225. Pursh, Flora, 263. Elliott, Sketch, 1. 444. Torr. & Gray, Flora, 1. 498. Torrey, Flora New York, 1. 235. Matthews, Fl. Acadia, 20. Gray, Manual, 179.

Œ. gracilis. Schrad., "Ind. Sem. h. Gött."

Œ. riparia. Lehm.; Hook., Fl. Bor. Am., 1. 212; not Nutt.

Kneiffia pumila and *chrysantha.* Spach, Monog., 47 and 48, excl. vars.

53. ŒNOTHERA PURPUREA. Curtis, Bot. Mag., t. 352. Willd., Spec., 2. 311. Persoon, Ench., 1. 409. Ait., Hort. Kew., 2 ed., 2. 344. Seringe, DC. Prodr., 3. 49. Hook., Fl. Bor. Am., 1. 211. Don's Mill., 2. 688. Hook. & Arn., Bot. Beech., 341. Torr. & Gray, Flora, 1. 504. Dietr., Syn., 2. 1287. Bentham, Bot. Sulph., 15. Bolander, Cat., 12. Gray, Proc. Amer. Acad., 8. 384, in part. — No. 108 b. Bridges; 410 Bolander, and 282, in part; 193 Hall, in part; Douglas; Rich; Willey.

Œ. humilis. Donn, "Ind. h. Cant., 41." Poir., Suppl., 4. 144.

Godetia Willdenowiana. Spach, Monog., 68.

57. ŒNOTHERA QUADRIVULNERA. Dougl.; Lindl., Bot. Reg., 13. t. 1119. Lehm.; Hook., Fl. Bor. Am., 1. 213. Don's Mill., 2. 684. Torr. & Gray, Flora, 1. 504. Dietr., Syn., 2. 1285. Gray, Pac. R. R. Rep., 12. 61. — No. 533 Thurber, in part; 477, 2538 Brewer; 106 Torrey, in part; 270 Kell. & Harf.; Douglas; Nuttall; Tolmie; Wilkes; Pratten; Scouler; Williams; Bigelow; Suckley; Kellogg.

Godetia quadrivulnera. Spach, Monog., 69.

Œ. tenella, Var. *tenuifolia.* Hook. & Arn., Bot. Beech., 342, in part. Torr. & Gray, Flora, 1. 504.

Œ. viminea. Torrey, Pac. R. R. Rep., 4. 86, in part.

Œ. purpurea. Durand, Pl. Pratten., 88, in part.

4. ŒNOTHERA RHOMBIPETALA. Nutt.; Torr. & Gray, Flora, 1. 493. Walpers, Repert., 2. 81. Torrey, Fremont's Rep., 89; Marcy's Rep., 285; Sitgreave's Rep., 175. Kunze, Linnæa, 20. 57. Parry, Pl. Minnesota, 612. Engelm., Pl. Upp. Miss., 192. Gray, Manual, 178. — Fremont; Leavenworth; Parry.

Œ. Darlingtonii. Pickering, MS.

60. ŒNOTHERA ROMANZOVII. Ledeb., "Hornem. Hort. Hafn., 1. 133." Don; Lindl., Bot. Reg., 7. t. 562; (Spreng., Neue Entdeck., 3. 176). "Link, Enum., 378." Spreng., Syst., 2. 228. Seringe, DC. Prodr., 3. 49. Hook., Fl. Bor. Am., 1. 212. Don's Mill., 2. 688. Torr. & Gray, Flora, 1. 503. Dietr., Syn., 2. 1287.

Godetia Romanzovii. Spach, Monog., 70.

18. ŒNOTHERA ROSEA. Aiton, Hort. Kew., 2. 3. Curtis, Bot. Mag., t. 347. Seringe, DC. Prodr., 3. 51. Don's Mill., 2. 689. Gray, Pl. Wright., 2. 57. Torrey, Bot. Mex. Bound., 65. — No. 165 Coulter; 254, 651 Gregg; 1071 Wright; 361 Schott; 347, 699 Thurber.

Œ. rubra. Cav., Icones, 4. 68, t. 400.

Œ. purpurea. Lam., Dict., 4. 554.

Hartmannia gauroides. Spach, Monog., 41.

47. ŒNOTHERA SCAPOIDEA. Nutt.; Torr. & Gray, Flora, 1. 506. Walpers, Repert., 2. 86. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 224. Torrey, Stansbury's Rep., 387, in part. Durand, Fl. Utah, 164. Watson, King's Rep., 5. 109. — No. 94 Geyer; 96 Palmer; 414 Watson; Nuttall; Stansbury.

Var. PURPURASCENS. — No. 1845 Brewer; 415 Watson; 70 Anderson; Beckwith; Stretch.

Œ. clavæformis. Torr. & Gray, Pac. R. R. Rep., 2. 121.

Œ. cruciformis. Kellogg, Proc. Acad. Calif., 2. 227, fig. 71.

Œ. scapoidea, Var. *clavæformis.* Watson, King's Rep., 5. 109.

Var. AURANTIACA. — No. 180 Coulter, in part; 374 Parry; Fremont; Bigelow; Newberry; Cooper; Thomas; Almendinger.

Œ. clavæformis. Torrey, Fremont's Rep., 314; (Bot. Zeit., 5. 42;) Pac. R. R. Rep., 4. 86 and 5. 360; Bot. Mex. Bound., 66, in part. Walpers, Annal., 1. 291. Gray, Ives's Rep., 12.

36. ŒNOTHERA SERRULATA. Nutt., Genera, 1. 246. Torrey, Ann. N. Y. Lyc., 2. 201. Sweet, Brit. Fl. Gard., t. 133. Spreng., Syst., 2. 228. Seringe, DC. Prodr., 3. 49. Don's Mill., 2. 687. Torr. & Gray, Flora, 1. 501; Pac. R. R. Rep., 2. 164. Dietr., Syn., 2. 1286. Torrey, Nicollet's Rep., 150; Fremont's Rep., 89; Marcy's Rep., 285; Pac. R. R. Rep., 4. 86; Bot. Mex. Bound., 65. Engelm., Wislizenus's Rep., 3; Pl. Upp. Miss., 191. Parry, Fl. Minnesota, 612. Gray, Pac. R. R. Rep., 12. 43; Proc. Acad. Phil., 1863, 61; Manual, 179. Bourgeau, Palliser's Rep., 256. Porter, Hayden's Rep., 1870, 476. — No. 192 Nicollet; 17, 201, 455 Fremont; 1957 Berlandier; 229 Fendler; 179 Hall & Harb.; 182 Vasey; 61 Houghton; James; Nuttall; Franklin; Marcy; Beckwith; Thurber; Suckley; Bourgeau; Engelmann; Lesquereux; Kern; Buckley; Hale.

Calylophis Nuttallii. Spach, Monog., 17.

Œ. fruticosa. Gray, Pl. Fendl., 44.

Meriolix serrulata. Walpers, Repert., 2. 79; Annal., 2. 532.

Var. PINIFOLIA. Engelm.; Gray, Pl. Lindh., 189; Hall's Pl. Tex., 9. — No. 567, 1048, 2478 Berlandier; 394 Lindheimer; 209 Hall.

Œ. capillifolia. Scheele, Linnæa, 21. 576.

Var. DOUGLASII. Torr. & Gray, Flora, 1. 502; Pac. R. R. Rep., 2. 126. Gray, Pl. Fendl., 45. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 224.

Œ. leucocarpa. Lehm.; Hook., Fl. Bor. Am., 1. 210; Nov. Stirp., pug. 2. 17. Don's Mill., 2. 687. Dietr., Syn., 2. 1287.

Var. DRUMMONDII. Torr. & Gray, Flora, 1. 502.

Calylophis Drummondiana and ? *Berlandieri.* Spach, Monog., 18.

Meriolix Berlandieri. Walpers, Repert., 2. 79.

Œ. spinulosa, Var. *Drummondii.* Engelm., Pl. Upp. Miss., 192.

Var. SPINULOSA. Torr. & Gray, Flora, 1. 502. Gray, Pl. Lindh., 36 and 189; Pl. Wright., 1. 71; Hall's Pl. Tex., 9. Scheele, Römer's Texas, 430. — Nos. 479, 1829, 1919 Berlandier; 79 Drummond; 238, 393 Lindheimer; 195 Wright; 208 Hall; Nuttall; Fremont; Hobart.

Œ. spinulosa. Nutt., MS.

Œ. serrulata. Nutt., Journ. Acad. Phil., 2. 120; (Litt. Ber. zu Linnæa, 1829, 40.) Hook., Exot. Fl., t. 140.

7. ŒNOTHERA SINUATA. Linn., Mant., 2. 228. Murr., "Comm. Gött., 5, t. 9." Ait., Hort. Kew., 2. 3. Michx., Flora, 1. 224. Pursh, Flora, 261. Elliott, Sketch, 1. 443. Spach, Monog., 29. Hook., Comp. Bot. Mag., 1. 25. Torr. & Gray, Flora, 1. 494; Pac. R. R. Rep., 2. 164. Bentham, Pl. Hartw., 6. Scheele,

Römer's Texas, 431. Torrey, Marcy's Rep., 285; Bot. Mex. Bound., 65. Lesquereux, Fl. Ark., 360. Chapman, Flora, 138. Gray, Manual, 178; Hall's Pl. Tex., 9. — Nos. 166, 170 Coulter; 1066, 2496 Berlandier; 11 Hartweg; 221, 244 Fendler; 368 Lindheimer; 133 Palmer; 677 Ghiesbrecht; 206 Hall.

Œ. laciniata. Hill, "Syst. Veg., 12, Appx., and plate"; Hort. Kew., 172^4, t. 6.

Onagra sinuata. Moench., Methodus, 676.

Œ. prostrata. Ruiz & Pav., Fl. Peru., 3. 79, t. 315. DC. Prodr., 3. 48.

? *Œ. viscosa.* Raf., Fl. Lud., 96.

Var. MINIMA. Nutt., Genera, 1. 245. Hook., Bot. Mag., t. 3392; Pl. Geyer in Lond. Journ. Bot., 6. 221. — No. 134 Palmer.

Œ. minima. Pursh, Flora, 262, t. 15. Spreng., Syst., 2. 228. Seringe, DC. Prodr., 3. 49. Don's Mill., 2. 687. Spach, Monog., 29.

Var. HIRSUTA. Torr. & Gray, Flora, 1. 494. Gray, Pl. Fendl., 43; Hall's Pl. Tex., 9. — No. 75 Drummond; 202 Hall; Nuttall; Linsecum.

Œ. Mexicana. Spach, Monog., 27. Walpers, Repert., 2. 81.

Var. GRANDIFLORA. — No. 132 Palmer; 203 Hall; Wright.

? *Œ. longiflora.* Scheele, Römer's Texas, 430; not Jacq.

Œ. sinuata. Gray, Hall's Pl. Tex., 9, in part.

13. ŒNOTHERA SPACHIANA. Torr. & Gray, Flora, 1. 498; Pac. R. R. Rep., 2. 164. Walpers, Repert., 2. 84. Gray, Pl. Wright., 1. 70; Hall's Pl. Tex., 9. — No. 81 Drummond, in part; 206 Hall; Lindheimer; Wright; Pope; Hall.

Blennoderma Drummondii. Spach, Monog., 86.

Œ. Drummondii. Walpers, Repert., 2. 85; not Hook.

? *Œ. uncinata.* Scheele, Linnæa, 21. 578. Gray, Pl. Lindh., 190. Walpers, Annal., 2. 534.

17. ŒNOTHERA SPECIOSA. Nutt., Journ. Acad. Phil., 2. 119; (Litt. Ber. zu Linnæa, 1829, 40.) Hook., Exot. Flora, 2. t. 80; Bot. Mag., t. 3189. Spreng., Syst., 2. 230. Seringe, DC. Prodr., 3. 50. Don; Sweet, Brit. Fl. Gard., t. 253. Don's Mill., 2. 688. Torr. & Gray, Flora, 1. 496; Pac. R. R. Rep., 2. 126 and 164. Dietr., Syn., 2. 1289. Walpers, Repert., 2. 85. Torrey, Fremont's Rep., 89; Marcy's Rep., 285; Pac. R. R. Rep., 4. 86. Gray, Pl. Fendl., 44; Pl. Lindh., 8 and 31 and 189; Pl. Wright., 1. 70; Hall's Pl. Tex., 9. Engelmann, Wislizenus's Rep., 3. Scheele, Römer's Texas, 431. — Nos. 187, 869, 1087, 1447, 1484, 1833, 2326, 2433, 2517 Berlandier; 78, 79 Drummond, and 81, in part; 35, 55, 409 Lindheimer; 415, 440 Wright; 370 Schott; 127 Palmer; Nuttall; Gregg; Fremont; Pitcher; Thurber; Hobart; Hale.

Xylopleurum hirsutum, Nuttallii, Drummondii, and *obtusifolium.* Spach, Monog., 50-52.

Œ. Spachii and *obtusifolia.* Dietr., Syn., 2. 1289.

Œ. Drummondii. Schnitzlein, Icon., t. 265, f. 1; not Hook.

45. ŒNOTHERA STRIGULOSA. Torr. & Gray, Flora, 1. 512. Dietr., Syn., 2. 1284. Torrey, Pac. R. R. Rep., 4. 87, in part, [and 7. 11 ?] — No. 694 Wilkes; 407, 2590 Brewer; Nuttall; Spalding; Bigelow; Rich; Fitch.

Sphærostigma strigulosum. Fisch. & Mey., Ind. Sem. h. Petr., 2. 25; (Ann. Sci. Nat., 2. 5. 187; Litt. Ber. zu Linn., 1837, 120; Hook., Comp. Bot. Mag., 2. 9.) Walpers, Repert., 2. 79.

Œ. contorta. Hook., Fl. Bor. Am., 1. 214. Don's Mill., 2. 685. Spach, Monog., 16. Torr. & Gray, Flora, 1. 511. Dietr., Syn., 2. 1285. [? Hook., Pl. Geyer in Lond. Journ. Bot., 6. 224.]

Œ. parvula. Nutt.; Torr. & Gray, Flora, 1. 511.

Sphærostigma contortum and *parvulum.* Walpers, Repert., 2. 78.

Var. PUBENS. — No. 219 Fremont; 181 Stretch; 99, 155 Anderson; 100 Torrey; 276, 498, 550, 715, 3934 Brewer; 3857, 3954, 6419 Bolander; 422, 423 Watson; Bigelow; Suckley; Spalding; Lyall; Fitch; Shelton; Rich; Kellogg.

Œ. dentata. Watson, King's Rep., 5. 111.

58. ŒNOTHERA TENELLA. Cav., Icon., 4. **t. 396, f. 2.** Ruiz & Pav., Pl. Peruv., 3. **t. 316.** Persoon, Ench., 1. 408. Poir., Suppl., 4. 141. Spreng., Syst., 2. 228. Sweet, Brit. Fl. Gard., **t. 167.** Seringe, DC. Prodr., 3. 48. Don's Mill., 2. 687. Torr. & Gray, Flora, 1. 504, excl. var. Dietr., Syn., 2. 1287. — No. 533 Thurber, mostly; 108 Bridges; 508, 519, 638 Brewer; 106 Torrey, mostly; 10 Blake; 193 Hall, in part; Bigelow; Parry; Bolander.

Godetia Cavanillesii. Spach, Monog., 71. Gay, Fl. Chil., 2. 358.

Œ. viminea, Var. *parviflora.* Hook. & Arn., Bot. Beech., 342. Torrey, Pac. R. R. Rep., 4. 86.

Œ. viminea. Torrey, Pac. R. R. Rep., 4. 86, in part.

Œ. purpurea. Gray, Proc. Amer. Acad., 8. 384, in part.

67. ŒNOTHERA TORREYI. — No. 109 Torrey; 189 Hall.

Œ. densiflora, Var. *tenella.* Gray, Proc. Amer. Acad., 8. 384.

9. ŒNOTHERA TRICHOCALYX. Nutt.; Torr. & Gray, Flora, 1. 494. Walpers, Repert., 2. 80. Torrey, Fremont's Rep., 89. Hook., Pl. Geyer in Lond. Journ. Bot., 6. 222. Gray, Pl. Wright., 2. 56. Newberry, Pac. R. R. Rep., 6. 74. — No. 160 Stretch; 101 Torrey; 1217, 1590 Brewer; 293 Anderson; 409 Watson; Nuttall; Fremont; Newberry; Schott; Cooper; Palmer.

Œ. deltoidea. Torrey, Fremont's Rep., 315; (Bot. Zeit., 5. 42.) Walpers, Annal., 1. 291. Watson, King's Rep., 5. 107.

Œ. albicaulis, Var. *trichocalyx.* Engelm., Amer. Jour. Sci., 2. 33. 335, in part.

21. ŒNOTHERA TRILOBA. Nutt., Journ. Acad. Phil., 2. 118; (Litt. Ber. zu Linnæa, 1829, 40.) Hook., Bot. Mag., **t. 2566.** Seringe, DC. Prodr., 3. 49. Reich., Hort. Bot., 2. 18, **t. 145.** Barton, Fl. N. Am., **t. 37.** Don's Mill., 2. 689. Torr. & Gray, Flora, 1. 499; Pac. R. R. Rep., 2. 164. Dietr., Syn., 2. 1288. Gray, Pl. Lindh., 189; Pl. Wright., 1. 70 and 2. 58; Proc. Acad. Phil., 1863, 61. Torrey, Bot. Mex. Bound., 65. Bourgeau, Palliser's Rep., 256. Watson, King's Rep., 5. 107. — No. 392 Lindheimer; 1375 Wright; 365 Bigelow; 175 Hall & Harb.; 410 Watson; 137 Eaton; 177 Vasey; Nuttall; Bourgeau; Leavenworth; Pitcher; Smith; Bol. & Kell.

Œ. rhizocarpa. Spreng., Syst., 2. 230. Seringe, DC. Prodr., 3. 50. Dietr., Syn., 2. 1288.

Lavauxia Nuttalliana. Spach, Monog., 38, **t. 31, f. 1.**

Œ. clandestina. Nutt., MS.

Œ. Rœmeriana. Scheele, Linnæa, 22. 154. Walpers, Annal., 2. 533.

35. ŒNOTHERA TUBICULA. Gray, Pl. Wright., 1. 71 and 2. 58. Torr. & Gray, Pac. R. R. Rep., 2. 164. Torrey, Bot. Mex. Bound., 66. Walpers, Annal., 4. 676. — No. 1077 Wright, and 197, in part; 372 Bigelow; Pope.

59. Œ. VIMINEA. Dougl.; Hook., Bot. Mag., t. **2873**. Lindl., Bot. Reg., 15. t. **1220**. Lehm.; Hook., Fl. Bor. Am., 1. 211. Don's Mill., 2. 688. Torr. & Gray, Flora, 1. 503. Dietr., Syn., 2. 1287. Torrey, Pac. R. R. Rep., 4. 86, in part, and 7. 11; Bot. Mex. Bound., 66. Bolander, Cat., 12. — No. 108 Bridges; 4919, 6367 Bolander; 102 Torrey; 265, 271 Kell. & Harf.; Bigelow.

Godetia viminea. Spach, Monog., 69.

? *Œ. tenella*, Var. *tenuifolia*. Lindl., Bot. Reg., 19. t. **1587**.

Var. INTERMEDIA. Kellogg, Proc. Acad. Calif., 1. 60.

56. ŒNOTHERA WILLIAMSONI. Durand & Hilgard, Pac. R. R. Rep., 5. 7, t. **5**. — No. 107 Bridges; 150 Rattan; Heermann.

Godetia Lindleyi, var. Dur. & Hilg., Journ. Acad. Phil., 3. 39.

23. ŒNOTHERA WRIGHTII. Gray, Pl. Wright., 2. 57; Pl. Thurb., 300. Torr. & Gray, Pac. R. R. Rep., 2. 164. Torrey, Bot. Mex. Bound., 65, in part. Walpers, Annal., 4. 676. — Nos. 1072, 1374 Wright; Smith.

Cross-References.

Anogra Douglasiana and *Nuttalliana* = Œ. albicaulis.
Baumannia Douglasiana and *Nuttalliana* = Œ. albicaulis.
Blennoderma Drummondii = Œ. Spachiana.
Boisduvalia Douglasii = Œ. densiflora.
Calylophis Berlandieri, *Drummondiana*, and *Nuttallii* = Œ. serrulata.
Godetia Cavanillesii = Œ. tenella.
G. decumbens = Œ. lepida.
G. Lehmanniana, *Lindleyana*, *macrantha*, *rubicunda*, and *vinosa* = Œ. amœna.
G. Lindleyi; Œ. Williamsoni.
G. Willdenowiana = Œ. purpurea.
Hartmannia gauroides = Œ. rosea.
Holostigma argutum = Œ. dentata.
H. Bottæ = Œ. bistorta.
Kneiffia angustifolia, *floribunda*, *maculata*, and *suffruticosa* = Œ. fruticosa.
K. chrysantha = Œ. pumila.
K. Fraseri = Œ. glauca, var.
Lavauxia Nuttalliana = Œ. triloba.
Meriolix Berlandieri = Œ. serrulata, var.
Œ. alata; Œ. Missouriensis; Jussiæa sp.?
Œ. albicaulis; Œ. pinnatifida; trichocalyx.
Œ. ambigua = Œ. fruticosa, var.
Œ. arcuata = Œ. amœna.
Œ. Arnottii = Œ. lepida, var.
Œ. asperifolia = Œ. micrantha.
Œ. bifrons = Œ. heterophylla.
Œ. bistorta; Œ. micrantha.
Œ. Bradburiensis = Œ. pinnatifida.
Œ. Californica = Œ. Bottæ.
Œ. Canadensis = Œ. fruticosa, var.
Œ. capillifolia = Œ. serrulata, var.
Œ. cheiranthifolia; Œ. bistorta; Œ. micrantha.
Œ. chrysantha = Œ. pumila.
Œ. clandestina = Œ. triloba.
Œ. clavæformis; Œ. brevipes; Œ. scapoidea.
Œ. contorta; Œ. cheiranthifolia; Œ. strigulosa.
Œ. coronopifolia; Œ. pinnatifida.
Œ. cruciata = Œ. biennis, var.
Œ. cruciformis = Œ. scapoidea, var.
Œ. Darlingtonii = Œ. rhombipetala.
Œ. decumbens = Œ. lepida, var.
Œ. deltoidea = Œ. trichocalyx.
Œ. densiflora; Œ. lepida; Œ. Torreyi.
Œ. dentata; Œ. micrantha; Œ. strigulosa.
Œ. Drummondii; Œ. Spachiana; Œ. speciosa.

Œ. eximia = Œ. cæspitosa.
Œ. Fendleri = Œ. Greggii, var.
Œ. Fraseri = Œ. glauca, var.
Œ. fruticosa; Œ. glauca; Œ. serrulata.
Œ. gauroides = Œ. biennis.
Œ. graciliflora; Œ. bistorta.
Œ. gracilis = Œ. pumila.
Œ. grandiflora; Œ. biennis, var.
Œ. guttulata = Œ. canescens.
Œ. Hartwegi; Œ. Greggii.
Œ. heterophylla; Œ. bistorta.
Œ. hirta = Œ. micrantha.
Œ. Hookeri = Œ. biennis, var.
Œ. humilis = Œ. purpurea.
Œ. hybrida = Œ. fruticosa.
Œ. imbricata = Œ. densiflora.
Œ. incana = Œ. fruticosa, var.
Œ. insignis = Œ. Greggii, var.
Œ. laciniata = Œ. sinuata.
Œ. Lamarckiana = Œ. biennis, var.
Œ. Lampasana = Œ. Greggii.
Œ. lavandulæfolia = Œ. Greggii, var.
Œ. Leona = Œ. heterophylla.
Œ. leptophylla = Œ. albicaulis, var.
Œ. leucocarpa = Œ. serrulata, var.
Œ. Lindleyi = Œ. amœna.
Œ. linearis = Œ. fruticosa, var.
Œ. lithospermoides = Œ. Boothii.
Œ. longiflora = Œ. sinuata, var.
Œ. macrantha = Œ. amœna.
Œ. marginata; Œ. brachycarpa; Œ. cæspitosa.
Œ. maritima = Œ. cheiranthifolia.
Œ. media = Œ. fruticosa, var.
Œ. Mexicana = Œ. sinuata, var.
Œ. minima = Œ. sinuata, var.
Œ. mollissima = Œ. fruticosa.
Œ. montana = Œ. cæspitosa.
Œ. muricata = Œ. biennis.
Œ. Nevadensis = Œ. gauræflora.
Œ. Nuttallii; Œ. albicaulis; Œ. breviflora.
Œ. Oakesiana = Œ. biennis, var.
Œ. obtusifolia = Œ. speciosa.
Œ. odorata = Œ. biennis, var.
Œ. pallida = Œ. albicaulis.
Œ. paludosa = Jussiæa, sp.?
Œ. parviflora = Œ. biennis, var.
Œ. parvula = Œ. strigulosa.
Œ. pilosella = Œ. fruticosa, var.
Œ. pinnatifida; Œ. albicaulis; Œ. coronopifolia.
Œ. prostrata = Œ. sinuata.
Œ. pubescens = Œ. biennis, var.
Œ. purpurea; Œ. albescens; Œ. lepida; Œ. quadrivulnera; Œ. rosea; Œ. tenella.
Œ. Purshiana = Œ. pinnatifida.
Œ. pusilla = Œ. pumila.
Œ. pygmæa = Œ. Boothii.
Œ. rhizocarpa = Œ. triloba.
Œ. rhombipetala; Œ. heterophylla.
Œ. riparia; Œ. fruticosa; Œ. pumila.
Œ. Roemeriana = Œ. triloba.
Œ. roseo-alba = Œ. amœna.
Œ. rubicunda; Œ. amœna; Œ. Bottæ; Œ. epilobioides; Œ. hispidula.
Œ. rubra = Œ. rosea.
Œ. salicifolia = Œ. densiflora.
Œ. scapigera = Œ. cæspitosa.
Œ. scapoidea = Œ. alyssoides, var.
Œ. serotina = Œ. fruticosa, var.
Œ. sinuata; Œ. Drummondii; Œ. humifusa.
Œ. Spachii = Œ. speciosa.
Œ. spinulosa = Œ. serrulata, var.
Œ. spiralis = Œ. cheiranthifolia.
Œ. strigulosa; Œ. dentata; Œ. micrantha.
Œ. suaveolens = Œ. biennis, var.
Œ. tenella; Œ. biloba; Œ. Bottæ; Œ. epilobioides; Œ. quadrivulnera; Œ. viminea.
Œ. tetragona = Œ. fruticosa.
Œ. triloba; Œ. heterantha.
Œ. uncinata = Œ. Spachiana.
Œ. viminea; Œ. epilobioides; Œ. lepida; Œ. quadrivulnera; Œ. tenella.
Œ. vinosa; Œ. amœna; Œ. epilobioides.
Œ. viridescens = Œ. cheiranthifolia.
Œ. viscosa = Œ. sinuata.
Œ. Whitneyi = Œ. grandiflora.

Œ. Wrightii; Œ. Fremontii.

Onagra chrysantha, muricata, and *vulgaris* = Œ. biennis.

O. Linkiana = Œ. fruticosa, var.

Pachylophis Nuttallii = Œ. cæspitosa.

Sphærostigma contortum and *parvulum* = Œ. strigulosa.

S. hirta = Œ. micrantha.

S. spirale and *viridescens* = Œ. cheiranthifolia.

Xylopleurum, species = Œ. speciosa.

Characters of New Ferns from Mexico. By Daniel C. Eaton.

Polypodium Ghiesbreghtii. Caudice repente, penna anserina vix minore, paleis longissimis angustis mollibus pallide fulvis densissime onusto; stipite gracili levi 3 – 6 pollicari; fronde subdeltoideo-oblonga chartacea glauca tandem fulva spithamea ad pedalem, profunde pinnato-lobata, segmentis oblongis obtusis vel acutiusculis, terminati sat magno integro, lateralibus 5 – 9 paribus basi sursum currente confluentibus, 2 – 3 poll. longis, $\frac{1}{2}$ – $\frac{3}{4}$ poll. latis; venulis Goniophlebii, areolis costalibus soriferis, marginalibus parvis 1 – 2 seriatis, soris majusculis mediis inter costam et marginem; sporis reniformibus.

A very handsome fern somewhat related to *P. loriceum*, but abundantly distinct from all the species to which I have been able to compare it. Lowest segments nearly as large as any of the middle ones, very slightly deflexed, subcordate on the lower side, the upper side being extended as a broad wing along the rachis, in some specimens fairly overlapping the subcordate basis of the next pair. In the middle of the frond the segments are separated by a broad, rounded sinus. The wing left on the costa is about half an inch wide, and bears an occasional fruit-dot. The fronds are at first of a pale glaucous green, but eventually, perhaps in drying, turn to a bright brown. The veins, seen by transmitted light, are blackish where they leave the costula, but become less visible toward the edge of the segments. When the slender tips of the scales of the caudex are broken off they leave ragged brownish imbricated scales, and when these are removed a pale-bluish surface is discovered. The stem or petiole is very slender, perfectly smooth, and with the rachis is of a brownish straw-color. I take great pleasure in naming this fine Polypodium after its discoverer, Dr. A. Ghiesbreght, who found it growing on oaks in the cooler region of Chiapas. It is No. 273 of his distribution.

Polypodium stenoloma. Glabrum; stipite fusco subspithameo, fere ad basin angustissime alato; fronde membranacea, glabra, circumscriptione ovata, 10 – 13 poll. longa, latitudine $\frac{2}{3}$ longitudinis, pinnatifida; segmentis 4 – 6 paribus præter terminale consimile, lanceolatis, 3 – 4 poll. longis, $\frac{3}{4}$ poll. latis, acuminatis, subintegerrimis, basi paullo angustatis, dein in alam racheos angustam utrinque dilatatis; venulis more Goniophlebii reticulatis, areolis paracostalibus magnis, soriferis, ceteris minimis vel nullis; soris oblongis, obliquis, costulæ subapproximatis. — Chiapas, Mexico, Dr. Ghiesbreght, No. 386.

This fern is closely related to the form of *Polypodium sororium* which has reticulated veins, but differs considerably from that species in having much fewer pinnæ or segments, and the terminal one nearly or quite as large as any of the others. The wing which borders the rachis is continued downwards in a narrow border each side of the stipe almost to its base. The fruit-dots are considerably elongated, as in *P. sororium* and *P. trilobum*.

ASPLENIUM NIGRICANS. Caudice brevi repente, paleis angustis nigrescentibus onusto; stipitibus crebris, rigidis, teretibus, nudis, atrosangineis, lucidis, 4 – 6 uncialibus, diametro lineam fere æquantibus; fronde opaca, nigro-fuscescente, subcoriacea, fere pedali, pinnata; pinnis utrinque 12 – 20 præter terminalem angustam acuminatam, pollicem longis, 3 – 5 lineas latis infimis triangulari-ovatis costula centrali; ceteris cultriformibus, obtusis, sursum leviter curvatis, basi superiori rachi parallelis, inferiori linea subrecta excisis, crenato-denticulatis; soris majusculis, infra costulam 1 – 3, supra eam uno vel sæpius nullo. — Chiapas, Dr. Ghiesbreght, No. 377.

The highly polished and nearly black stipes and rachis, together with the shape of the pinnæ and the small number of rather large sori, nearly all on the lower side of the pinnæ, indicate a place for this Fern not far from *A. monanthemum*, but in the size and comparative fewness of the pinnæ the resemblance is rather to *A. lætum*. The whole frond is so dark as to be almost black, and is utterly devoid of lustre. The rachis, though terete and rigid, has an exceedingly narrow brownish line on each side connecting the points where the pinnæ are inserted. — *A. nigricans* of Kunze being now by general consent referred to *A. furcatum*, this name becomes available for the present use.

Characters of New Genera and Species of Plants. By Asa Gray.

BREWERINA Nov. Gen. *Silenearum.*

Præter stigmata terminalia capitellata et semina ovalia *Arenariæ* persimilis cum inflorescentia *Holostei.* — Sepala 5, ovata, margine scariosa. Petala 5, spathulata, cum staminibus 10 longius exsertæ, marcescentia. Discus perigynus staminifer brevissimus. Ovarium uniloculare, 6–8-ovulatum: styli 3, capillares, stigmatibus parvis capitellatis terminati! Ovula campylotropa, in placenta basilari brevi sessilia. Capsula ovato-globosa, crustacea in valvulas, 3 mox bifidas dehiscens. Semina abortu 2–4, ratione capsulæ magna, lato-ovalia, a latere compressa, hilo marginali, micropyle rostellata; testa lævi laxa molli, nucleo conduplicato. — Herba basi ramosissima suffruticosa; foliis acerosis; ramis floridis gracilibus simplicissimis cyma densa umbelliformi terminatis; bracteis involucrantibus brevibus scariosis.

Brewerina suffrutescens. — Sierra Nevada above Cisco, and between Truckee and Donner Lake, California, coll. Bolander and Kellogg. — Glabrous, the lower part of the stem and leaves minutely glandular. Stems much branched and decidedly woody at base, the plant forming broad matted tufts, a span or more high, leafy only at the ends of these branches, from which rise simple flowering stems of the season, a foot or less in height, slender, bearing a few pairs of leaves separated by long internodes, of which the upper one terminated by the inflorescence is 3 or 4 inches long. Leaves crowded on the persistent branches, rigid, acerose, about an inch long, a quarter of a line wide, mucronate; on flowering stems becoming shorter and with scarious connate bases. Stipules none. Flowers about half the size of those of *Holosteum umbellatum*, numerous and crowded in a solitary umbelliform cluster, which is involucrate by a few short ovate-lanceolate scarious bracts: central and oldest pedicels very short; the others 2 to 5 lines long. Sepals ovate, obtuse, herbaceous with scarious margins. Petals white, spatulate, between 2 and 3 lines long, about twice the length of the calyx. Filaments filiform, equalling the petals. Ovary globose. Capsule slightly exceeding the calyx. The seeds examined not perfectly mature, over a line in length, laterally compressed, erect, completely sessile on the very short columnar placenta; the testa soft, membranaceous, apparently somewhat fleshy and loose, perhaps margined, the micropyle extended beyond the marginal basilar hilum as if into a broad rostellum. Embryo not fully developed in the specimens. — The terminal stigma (which, so far as I know, is wholly anomalous in *Caryophyllaceæ*), the *Holosteum*-like inflorescence, the few seeds, which are neither those of *Holosteum* nor of *Arenaria*, and the suffrutescent growth, combine to justify the establishment of a new genus for this plant. As it belongs to the Flora of California, which he has for several years been engaged upon, and for which he has personally collected most important and ample materials, I propose to dedicate the genus to Professor William H. Brewer, of the California Geological Survey and of Yale College. That he may not be deprived of this well-earned honor on account of the old genus *Breweria*, I have written the name *Brewerina*.

AQUILEGIA CHRYSANTHA. *A. cæruleæ*, Torr. affinis, elatior (2–4-pedalis), floribunda; floribus saturate flavis; sepalis lanceolato-oblongis limbo petalorum paullo longioribus haud latioribus. — *A. leptocera* var. *flava* Gray, Pl. Wright. 2, p. 9; Bot. Mex. Bound. p. 30. — Eastern New Mexico (Organ Mountains not far from El Paso, Thurber, Wright; and further north, Parry) to Arizona (Mabibi, Parry, etc.). Also in South Utah? A. L. Siler (fide Meehan). Now in cultivation from seeds collected by Dr. Parry, and distributed from the Botanic Garden of Harvard University. See American Agriculturist for September, 1873, for an account of the plant, with woodcut, etc. Upon first acquaintance with this plant in dried specimens, I regarded it as a variety of the blue, long-spurred *Aquilegia* of the Rocky Mountains, some forms of which are almost or entirely white-flowered. In view of the diversity of color, and this more remarkable deviation to yellow, I was the more disposed to follow Sir William Hooker in preferring Nuttall's appropriate name of *A. leptocera*, trusting that the *A. leptoceras* of Fischer might not be a good species. But now that we have this golden Columbine in cultivation for the second season, and can review its characters, we must conclude that it may claim a distinct specific name, although the technical characters may seem to be slender. Its geographical range is different; it occupies a more southern range, and is found at less elevation than *A. cærulea*. Here at Cambridge, at least, it is more hardy, probably because it bears our summers better than its alpine relative; and it endures our winter perfectly. It is much taller, rising to the height of four feet in the rich and moist soil which it prefers; it comes into flower nearly a month later, branches freely into a panicle, and continues in bloom through the whole summer. The color of the blossom is a clear yellow, the petals of a rather deeper hue than the sepals. The sepals and the limb of the petals are not so ample as in *A. cærulea*, the former hardly exceeding an inch in length and five lines in width; they barely equal the latter in breadth, and do not much exceed them in length. The long spurs are similar, very slender, and over two inches in length. If the flowers individually are not so showy as those of *A. cærulea*, they make it up in their number and longer continuance, and are remarkable for their color.

WISLIZENIA PALMERI. Foliis superioribus (an omnibus?) simplicibus linearibus petiolo pluries longioribus; floribus fructuque præsertim majoribus; valvis maturis oblongis nervosis circa extremitatem truncatam echinatis. — On the Lower Colorado (California and Arizona), Dr. Edward Palmer, 1869. This was overlooked in the naming of Dr. Palmer's valuable collections, but is an abundantly distinct species of this peculiar genus. The leaves, so far as seen, are simple, but those at the base of the stem are unknown; it may well be that they are trifoliolate, inasmuch as several of its relations are in the habit of bearing compound leaves below and simple ones toward the inflorescence. In this species they are commonly an inch and a half long and only two lines broad. The valves or lobes of the fruit are fully two lines long (twice the size of those of *W. refracta*) somewhat cylindraceous, many-nerved, very little reticulated, the truncate extremity encircled by a row of five or six stout spinous tubercles.

FRANKENIA JAMESII (Torr. in herb.). Fruticosa, ramosissima, pedalis, scabro-puberula; ramis fastigiatis; foliis linearibus marginibus arcte revolutis quasi-acerosis sæpius punctatis; petalis 5, lamina cuneata erosa ungui subæquilonga, appendice parva ad apicem integrum fere adnata; staminibus 6; stigmatibus terminalibus; ovulis 3 oblongolinearibus ex apice funiculi sub-basilaris prælongi pendulis. — Eastern base of the Rocky Mountains, on rocks and bluffs, Colorado Territory, James in Long's Expedition, Fremont; near Pueblo, Brandegee, J. H. Redfield, E. L. Greene. Western borders of Texas, C. Wright, no. 626. — Wright's specimen is out of flower. It is named as above by Dr. Torrey in my herbarium, on comparison with a fragment collected half a century ago by Dr. James, which he had recently determined, but had not published. It is now characterized from excellent specimens, in full blossom, collected on bluffs of the Arkansas, near Pueblo, by my excellent correspondent, Rev. E. L. Greene. The species is not only much more woody than the Californian *F. grandifolia* (which comes east into Nevada), but is peculiar in having the ovules reduced to three, one for each placenta, and resupinate on very long funiculi, which are inserted close to the base of the cell. The leaves are only 2 or 3 lines long, and much fascicled in the axils. Limb of the (white) petals 2½ to 3 lines long.

Calandrinia. A little Portulacaceous plant of the Rocky Mountains was several years ago inadvertently, not to say carelessly, referred by me to the wrong genus, namely, *Talinum pygmæum.* This has since been more or less confused with a nearly related species of the Californian sierras. Both belong to *Calandrinia,* having persistent calyx and estrophiolate seeds, and are of the type of *C. acaulis* and some other South American species. Characters are appended.

Calandrinia pygmæa. Acaulescens, glaber; caudice crasso (fusiformi vel napiformi); foliis rosulatis linearibus basi attenuatis scapis (plurimis 1 – 2 - pollicaribus) medio bibracteatis 1 – 3-floris longioribus; sepalis suborbiculatis quasi-truncatis dentibus glandulosis instructis; petalis 6 – 8 roseis inæqualibus; staminibus sæpius totidem; stigmatibus 3 – 5; stylo brevi vel subnullo; ovulis 15 – 20; seminibus lævibus nitidis (vix semilineam latis). — *Talinum pygmæum,* Gray in Engelm., Rep. Exped. Bryan., Sill. Jour. 33, p. 407, Proc. Amer. Acad. 7, p. 332; S. Watson, Bot. King, p. 42, pro parte. — Alpine region, Rocky Mountains of Colorado, and Wyoming to the Sierra Nevada in California, and Cascade Mountains, Washington Territory.

Calandrinia Nevadensis. Major; scapis 2 – 4 - pollicaribus folia sæpius adæquantibus, fructiferis apice incrassatis; sepalis orbiculari-ovatis nunc apiculatis margine integerrimis vel obsolete denticulatis; petalis 6 – 9 albis; staminibus fere totidem; ovulis 30 – 40; seminibus ($\frac{1}{16}$ unc. diam.) plerumque numerosis: cæt. præcedentis. — *Talinum pygmæum,* S. Watson, l. c. pro parte. — Subalpine region of Wahsatch and East Humboldt Mountains, S. Watson, and Sierra Nevada, California, at Summit and Cisco, Kellogg and Bolander. — Flowers about twice the size of those of *C. pygmæa,* the calyx 3 or 4, and in fruit 5, lines long.

Pachystima Canbyi. Surculoso-repens; foliis oblongo-linearibus parce denticulatis; pedicellis filiformibus elongatis; petalis oblongo-ovatis; stylo brevissimo. — Giles County, Virginia, on a bluff at the

"New River White Sulphur Springs," William M. Canby. — It is full time that this interesting accession to our Eastern United States flora should be published. While the original *P. Myrsinites* * occurs plentifully in most wooded districts from the Rocky Mountains to the Pacific in Northern California and Washington Territory, this is known at only one station in the Alleghany Mountains, and makes an addition to the list of those few genera (such as *Boykinia* and *Calycanthus*) which are divided between Eastern and Western North America. Mr. Canby discovered the Alleghanian species in 1868, and obtained flowering specimens upon a second visit to the station in the spring of 1869. It was submitted both to Dr. Torrey and to Dr. Curtis. The former determined the genus and indicated the specific characters; the latter proposed that it should bear the discoverer's name. Both these eminent botanists having passed away without taking any steps in the matter, it is left for me to carry their intentions into effect, and to connect with this well-marked species the name of its sole discoverer, one of the most active and excellent of our botanists of this generation. The following note respecting the station, which Mr. Canby has furnished, will be useful to botanists who may, it is hoped, make this most rare new species commonly known, and even bring it into cultivation.†

LINUM ADENOPHYLLUM. *Hesperolinon*, annum, fere glaberrimum; caule tenui effuse paniculato; pedicellis filiformibus flore 2–3-plo longioribus demum patentissimis; foliis alternis angustissime linearibus margine glandulis brevissime stipitatis seu dentiformibus creberrime ciliolatis; glandulis stipularibus parvis; sepalis oblongo-lanceolatis acutis margine rariter vixve glanduloso-denticulatis; petalis ut videtur flavis calyce subduplo longioribus, ungue lato ima basi utrinque unidentato intus appendice squamiformi parvo aucto; sinubus inter stamina nudis; antheris lineari-oblongis; stylis 3 gracilibus; stigmatibus minimis. — California, near Clear Lake, May, 1872, H. N. Bolander. — This is another trigynous *Linum*, related to *L. spergulinum* and *L. micranthum*, with flowers not larger than those of the latter; distinguished by the thickly set glandular ciliation of the leaves. A minute pubescence appears on the lower part of most of the internodes.

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* PACHYSTIMA MYRSINITES Raf. Erecta, dumosa, 1–2-pedalis; foliis ovalibus ovato-lanceolatis vel fere oblanceolatis magis serratis; pedunculis (pauci-vel plurifloris) pedicellisque brevibus; petalis late ovatis; stylo subulato. — Not being able to make out the etymology of the generic name, I am in doubt as to its gender. It may be neuter instead of feminine, as I have assumed it to be.

† I first saw this plant in August, 1858, on the top and near the edge of a jagged and very picturesque bluff of limestone rock, of about four hundred feet in perpendicular height, which causes a very abrupt bend in the "New River," flowing at its base. It is in Giles County, Virginia, at a place of summer resort called "The New River White Sulphur Springs." The top of the bluff and the hill beyond are covered with a forest of deciduous trees and cedars. Below in the clefts and in the shelves of the rock are found plentifully *Sedum telephioides*, *S. Nevii*, Gray, *Arenaria patula*, Michx., *Phacelia parviflora*, Pursh, and other interesting plants. At the time mentioned, *Pachystima* was neither in flower nor fruit. But again visiting the locality about the middle of May, 1869, I had the good fortune to find it in flower and a single specimen with an immature capsule, which at that stage of growth appears very much like that of *P. Myrsinites* Raf. W. M. C.

DALEA HALLII. Herbacea; caulibus gracilibus e radice perenni fusiformi decumbentibus laxe ramosis pube adpressa minuta cinereis; foliis pinnatim trifoliolatis glabratis; foliolis linearibus acutis rariter glandulosis petiolo haud complanato 2–3-plo longioribus; spica subsessili oblonga densiflora; bracteis ovato-lanceolatis sericeo-pubescentibus calycem haud superantibus; calyce villoso, dentibus e basi lata subulato-setaceis tubo subglandulifero longioribus; corolla flava, alis vexillum flabelliforme multo superantibus. — On limestone, Dallas, in Northeastern Texas, Elihu Hall, 1873, no. 132. — This is nearly related to *D. trifoliolata* Moricand, of Mexico, which is probably *D. prostrata* Ortega; but much more slender, branching, with narrower leaflets and petiole, smaller flowers, shorter bracts, and a minute close pubescence except on the bracts and calyxes.

HOSACKIA TORREYI. Molliter nunc sericeo-pubescens, inferne glabella; stipulis subulato-lanceolatis scariosis; foliolis 7–10 obovatis oblongo-ovatis vel fol. superiorum lanceolato-oblongis; pedunculis folium superantibus; umbella 3–7-flora bractea unifoliolata stipata; calycis villosi dentibus subulatis tubo æquilongis; vexillo saturate luteo, alis carinaque albis. Sierra Nevada, California, along the shady banks of streams, at the elevation of 4,000 feet and upwards; common from Clark's to the Yosemite Valley, where it has been collected by Bridges, Torrey, Bolander, and by myself.— Var. NEVADENSIS: pube tenuiori; bractea 3-foliolata; floribus minoribus. Near Donner Lake, Torrey. On account of the very neat particolored flowers, this species would be attractive in cultivation. I had at first (overlooking the stipules) taken it for a small-flowered variety of *H. grandiflora*, and afterwards supposed it might belong to the little-known *H. oblongifolia* Benth.

But a comparison which has been obligingly made at Kew with the unique original specimen belonging to the Herbarium of Trinity College, Dublin, shows that to be a different species, of more southern habitat, to which a specimen collected by Dr. Horn in Owens's Valley or at Fort Tejon seems to belong. As the species now at length discriminated and characterized was probably (after Mr. Bridges) first collected by the chief and Nestor of our science, of whom we have just been bereaved, it may most appropriately bear his venerated name.*

ASTRAGALUS LEMMONI. *Oroboidei:* striguloso-puberulus; caulibus e radice perenni adscendentibus diffusis gracillimis 1 – 2-pedalibus ramosis; foliolis plerisque 5-jugis lineari-oblongis (lin. 4 longis); stipulis discretis triangulari-lanceolatis petiolo brevi sæpius æquilongis; pedunculis folium adæquantibus; racemo spiciformi oblongo densifloro; floribus patentissimus parvis (lin. 3 longis); calycis dentibus attenuato-subulatis tubo campanulato æquilongis; vexillo emarginato carina duplo longiore; stylo brevi; stigmate capitato; ovario semi-bilocellato 8-ovulato; legumine subcoriaceo parvo (lin. 2½ longo) ovato-oblongo haud stipitato puberulo bilocellato, sutura dorsali intrusa, ventrali acuta, sectione transversa obcordata. — Sierra Valley, Sierra County, California, J. G. Lemmon, communicated by Dr. Bolander. — I am uncertain whether this was collected by Mr. Lemmon, or by Dr. Bolander himself; but it belongs to a collection from an interesting district of the Sierra Nevada, a part of which was gathered by Mr. Lemmon, who first botanized in this valley; wherefore the present very distinct species may well bear his name. The stigma is unusually large for an *Astragalus*, and distinctly capitate. The raceme does not elongate in fruiting. The corolla is seemingly white, with a tinge of purple, and perhaps of yellow.

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* The *Euhosackiæ veræ*, with obviously pinnate leaves and developed stipules, may readily be distinguished as follows: —

Stipules ample and foliaceous: the umbel many-flowered: calyx-teeth short.
 Very silky-villous: leaf-like bract near the umbel . . . H. INCANA.
 Villous-pubescent and viscid: the bract or leaf remote . H. STIPULARIS.
Stipules scarious.
 Bract much below the many-flowered umbel: calyx-teeth very short . . . . H. CRASSIFOLIA.
 Bract (when present) borne at the summit of the
  One – four-flowered slender peduncle.
   Leaflets 5 – 9, obovate or linear: bract 3-foliolate . H. ANGUSTIFOLIA.
   Leaflets 5 – 7, linear-lanceolate, acute at both ends: bract 1-foliolate or none . . . . . . H. LATHYROIDES.
  Several- (5 – 10-) or only from the lowest axils 2 – 4-flowered peduncle.
   Minutely appressed-pubescent, except below: bract 1-foliolate: corolla yellow and purplish . . H. OBLONGIFOLIA.
   Soft or silky-pubescent: bract 1 – 3-foliolate: vexillum yellow; wings and keel white . . . . . . H. TORREYI.
   Glabrous throughout or nearly so: claws of the petals elongated.
    Bract none, or a scarious rudiment: vexillum and keel yellow; wings white . . . . . H. BICOLOR.
    Bract 3-foliolate; vexillum yellow; keel and wings rose-purple . . . . H. GRACILIS.

IVESIA MUIRII. Nana (tantum pollicaris e caudice crasso); foliis confertis scapum 1–2-bracteatum capitato-pauciflorum subæquantibus myosuroideis, nempe foliolis 3–5-sectis segmentisque minimis subrotundis sericeo-villosissimis rhachin arctissime imbricantibus; petalis flavidis parvis demum lanceolatis calyce brevioribus; staminibus 5 brevibus; receptaculo circa carpella 2 longe villoso. — The foliage considerably resembles that of *I. santolinoides* on a dwarfed scale, and is equally silky. In all other respects it is of the same type as *I. pygmæa* and *I. lycopodioides*, but it has much smaller petals, which are said by the collector to be "yellow." They are only a line long; and the calyx, when spread out, 3 lines in diameter. Filaments half the length of the calyx-lobes. I have with pleasure named this little plant after my friend and valued correspondent, Mr. John Muir, an ardent explorer of the Sierras, especially of their glacial phenomena. He discovered it in 1872 on Mount Hoffmann, at the altitude of 9,500 feet. The specimen is just coming into blossom, and the scape is likely to be sometimes taller.

LONICERA. Some notes upon the Western American species are here appended.

§ CAPRIFOLIUM. The Pacific North American species are apparently only two, namely: —

L. CILIOSA Poir. (*Caprifolium* Pursh), of which *L. occidentalis* (*Caprifolium* Lindl. Bot. Reg. t. 1457) is a synonym. Oregon.

L. HISPIDULA Dougl. *Caprifolium hispidulum* Lindl. Bot. Reg. t. 1761. This reaches from the Columbia River through California, in a multitude of forms, to many of which the specific name is wholly inappropriate. The original, or

Var. DOUGLASII, includes also *L. microphylla*, Hook. Fl. Bor.-Am. That passes along the drier coast of California into

Var. SUBSPICATA, *L. subspicata* Hook. & Arn.; Torr. Bot. Mex. Bound. p. 71, t. 29; — a bushy and small-leaved form, with glandular pubescence on the inflorescence, calyx, and corolla.

Var. INTERRUPTA, *L. interrupta* Benth. Pl. Harwegianæ, is like it, but glabrous and mostly glaucous; the filaments perhaps less hairy at base.

Var. VACILLANS, *L. Californica* Torr. & Gray, includes various mostly stronger-growing, larger-leaved, and more climbing forms, with or without the spreading scattered hairs, and the inflorescence, calyx, etc., either conspicuously or obscurely glandular, — passing on one hand into the last, on the other into the first variety or form.

§ XYLOSTEUM DC. (*Xylosteum* Adanson.) The limb or teeth of the calyx cannot properly be said to be "deciduous" in any North American species except *L. involucrata.*

L. INVOLUCRATA, Banks, was published one year earlier than the volume which contains the character of *L. Ledebourii* of Eschscholtz, although the latter's paper was communicated to the St. Petersburg Academy two years before. The ample involucre consists of the common pair of large foliaceous bracts, and within, decussating with these, a pair of rounded and more scarious bractlets to each flower, generally connate two and two by their contiguous edges.

L. CÆRULEA L. Peduncle very short; bracts subulate and longer than the completely combined ovaries; bractlets none; corolla obscurely bilabiate, yellowish-white. In the Sierra Nevada of California and northward in Oregon occurs the form with villous corolla, as in Eastern Asia. In New England and north of it the corolla is nearly glabrous, and also shorter.

L. CILIATA Muhl. Peduncles slender; bracts subulate and minute; bractlets obsolete; corolla yellowish-white, obscurely bilabiate, the lobes short; ovaries distinct. Confined to the northern line of the Atlantic States and Canada; excepting Lyall's specimens from Pend Oreille River, British Columbia, which appear to be of this species, although the branches are erect and the leaves obtuse.

L. UTAHENSIS Watson, Bot. King, p. 133, is still uncertain for want of good flowers. By the foliage, bracts, etc., it might be this northwestern form of the preceding; but the single withered flower found is only half as large, apparently purplish, and shortly but distinctly bilabiate. It has much of the aspect, but not the bracts and ovaries, of *L. Chamissoi.*

L. CONJUGIALIS Kellogg, Proc. Acad. Calif. 2, p. 67, fig. 15. Kellogg's plant, from Washoe, Nevada, must needs be the same as my *L. Breweri*, Proc. Amer. Acad. 6, p. 537, and 7, p. 349, which I have since collected in Mariposa County, but never with peduncles longer than the leaves. It is at once known from all American species by the dull dark purple and deeply bilabiate corolla, and nearly obsolete bracts and bractlets. With its near relative in Eastern Asia, *L. Maximowiczii*, I have already compared it.

L. OBLONGIFOLIA Hook., confined to the Northern Atlantic States and Canada, also has a strongly bilabiate (yellowish-white) corolla, and long peduncles. The ovaries vary, even on the same shrub, from completely united to nearly distinct.

MONOTROPA (HYPOPITYS) FIMBRIATA. Pedalis, inflorescentia excepta glabra; racemo brevi conferta puberula; bracteis sepalisque obovato-cuneatis spathulatisque fimbriatis parce pilosis; antheris majoribus: flos raro trimerus. — *Pleuricospora fimbriolata* Gray in Proc. Am. Acad. 8, p. 394 (Oregon, E. Hall no. 357), not of 7, p. 396. This plant was carelessly misnamed by me: it is totally different from my *Pleuricospora*, except in the strikingly fimbriate-lacerate bracts, which misled me. There is some approach to this fimbriation in certain Eastern States specimens of *M. Hypopitys*, to which the present species is nearly related.

GHIESBREGHTIA, Nov. Gen. *Scrophulariacearum.*[*]

Calyx alte 5-partitus, segmentis linearibus æstivatione ut videtur valvatis. Corolla ventricosa, bilabiata; labio postico æstivatione exteriori erecto concavo breviter bilobo tubum late campanulatum adæquante, antico æquilongo trisecto patente, lobis oblongis planis. Stamina 2, fundo corollæ inserta, rudimentaria nulla: filamenta exserta, divergentia: antheræ biloculares, loculis mox divergentibus apice confluentibus. Stylus filiformis, e labio postico breviter exsertus: stigma subcapitato-bilobum. Capsula *Pentstemonis.* Semina numerosissima, oblonga, immarginata. — Frutex Mexicanus, orgyalis, ramis crebre foliatis, foliis alternis, pedunculis in axillis solitariis ebracteatis unifloris, flore magno "flavescente, odore suavo."

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[*] *Ghiesbreghtia* Ach. Richard is referred to *Calanthe.*

G. GRANDIFLORA. In a dry ravine near the town of Comitan, province of Chiapas, Mexico, in a temperate region, Dr. Ghiesbreght. — Young branches, foliage, etc., clothed with a fine soft pubescence. Leaves rather crowded, oval or oblong, about 2½ inches long, thickish, pinnately veined, few-toothed near the obtuse or barely acute apex, narrowed at the base into a short petiole. Peduncles solitary, an inch long, wholly bractless. Segments of the calyx nearly an inch in length, equal. Corolla nearly 3 inches long, glabrous within and mostly so without; the tube inflated from the very base; the upper lip broad, somewhat arching, 2-lobed at the summit; the divisions of the lower lip narrower, but of nearly the same length. Stamens equalling the upper lip of the corolla. Anthers at first hippocrepiform, the cells at length divaricate, dehiscent by a continuous line. Capsule of firm texture, an inch long, ovate, didymous, acute, 4-valved at the apex. Seeds minute, somewhat scobiform, smooth.

Apparently a remarkable new genus, which would naturally be referred to the *Cheloneæ*, except for the simple ebracteolate peduncles, and the slightly if at all imbricated sepals.

SCUTELLARIA PARVULA Michx., var. MOLLIS. Diffusa, majuscula undique molliter pubescens, pube subviscida; foliis sæpe ¾-pollicaribus. — Oquawka, Illinois, on the sandy banks of the Mississippi, H. N. Patterson. — So different in aspect is this plant from the ordinary *S. parvula* (which occurs in the vicinity), that I at first took it for *S. Drummondii*, and then for a distinct species; but I cannot detect sufficient characters; and these are transitions to the ordinary *S. parvula*. It produces similar moniliform strings of small tubers, each internode to the number of 8 or 10 thickening.

ERIOGONUM VILLIFLORUM. Acaule, pulvinato-cæspitosum, sericeo-villosum; foliis in caudice multicipiti subcrasso rosulato-confertissimis spathulato-lanceolatis (lin. 3 – 5 longis) albo-sericeis marginibus subrevolutis; scapo pollicari nudo; cyma capituliformi oligocephala bracteis linearibus 4 – 5 capitula breviter pedicellata paullo breviora involucrantibus stipata; involucris 6 – 8-fidis; perigonio campanulato (fundo lato) extus intusque sericeo ad medium usque 6-fido, lobis æqualibus albidis costa valida instructis; genitalibus glabris. — Kane County, Southern Utah, collected by Mr. Siler, communicated by Thomas Meehan. — A remarkable species, which, if the ovary were woolly, would be referred to the *Lachnogyna* section, but which actually seems, on the whole, to represent an acaulescent division of the *Fasciculata*.

Dirca occidentalis. Foliis ovalibus basi rotundatis; squamis involucri extus albido-villosis; floribus fructibusque fere sessilibus; perigonio breviter infundibuliformi tri-quadrilobo. — California, on the Oakland hills (perhaps in ravines), Dr. J. M. Bigelow (*D. palustris* Torr. Bot. Whippl. p. 77, non Linn.), Dr. A. Kellogg and W. G. W. Harford, no. 895 of distribution. — A second species of this before monotypical genus is of peculiar interest. The Californian *Dirca* was collected twenty years ago by Dr. Bigelow, "with flowers and young fruit," according to Dr. Torrey, but there are only vestiges of the former in my specimens. If they had been in good condition, Dr. Torrey would have noticed the characters of the species, which are now manifest. The white hairs of the floral bud-scales may not be constant; for in *D. palustris* they are occasionally pale; but the deep and rounded lobes of the more funnelform calyx are characteristic, being from one fourth to one third the length of the tube. Very commonly there are only three sinuses, one lobe being broader and emarginate. The stamens are uniformly eight. The original species may be thus characterized: —

Dirca palustris Linn. Foliis basi angustioribus; squamis involucri nigricanti-villosis; floribus pl. m. pedicellatis; perigonio tubuloso-infundibuliformi margine tantum repando. — Nova Scotia to Lake Superior and Lake of the Woods, and southward to Florida along the Alleghanies.

Notes on Compositæ and Characters of certain Genera and Species, etc. By Asa Gray.

The following notes and characters are partly in the way of commentary upon the recent most important revision of the order *Compositæ* by Mr. Bentham, in the second volume of Bentham and Hooker's *Genera Plantarum*, and partly the re-elaboration of certain genera, or the addition or reformation of species, chiefly such as have fallen in my way while engaged upon this portion of the Flora of California.

Hofmeisteria Walp. The character "pappi . . . paleis *acutis*" is indeed applicable to the later species, but not at all to Bentham's original species: the paleæ are rightly figured in Bot. Sulph. t. 14, as very truncate and lacerate at the summit.

Adenostyles Nardosmia. The Californian species referred to this genus in Gen. Pl. p. 247 is indeed an interesting and rather anomalous plant. I had in the first instance, as is stated, referred it to this genus; but afterwards, learning that the flowers were "of the color of yellow beeswax," had thought it necessary to place it in the *Senecioneæ;* and accordingly, in Proc. Am. Acad. 7, p. 361, I published it under the name of *Cacalia Nardosmia*, in view of the striking resemblance of the leaves to those of *Nardosmia palmata*, Hook., although the characters of the modern *Cacalia* were equally repugnant to yellow flowers. The great number of flowers in the head and their size are noteworthy peculiarities of the Californian species.

CARPHEPHORUS Cass. The character "pappi setæ 2–3-seriatæ, elongatæ, inæquales, scabræ vel breviter barbellatæ," in Gen. Pl. p. 249, applies only to the Atlantic United States species (and in them, even, the pappus is hardly more copious than in some species of *Brickellia*). As to the Californian species, Bentham himself ascribed to *C. junceus* "setis circa 15 longe et molliter plumosis," and *C. atriplicifolius* is just the same in these respects; the setæ are equal, rather stout, and in a single rank. The Californian species have a different habit, opposite leaves at the lower part of the *branching* stems, and shorter (but still spreading) lobes to the corolla, which apparently is not "purple"; since Dr. Cooper notes the flowers of *C. junceus* as yellow,—probably ochroleucous. Indeed, these Californian species are more closely related to *Brickellia* than the genuine *Carphephorus* is to *Liatris*, and still more to *Kuhnia*, into which they would fall if (as in *Ageratum*, etc.,) we were to disregard the chaff of the receptacle. So they may best be left where they are, but under a distinct section, *Kuhnioides*.

BRICKELLIA Ell.: p. 247. The bristles of the pappus are never so much as "breviter plumosæ," or perhaps even "subplumosæ" (as in Pl. Wright.): these phrases doubtless came from De Candolle's "barbellato-plumosæ" in the character of *Clavigera*, which was too strong.

XANTHOCEPHALUM Willd., including *Xanthocoma* HBK., is well made to include our *Gutierrezia gymnospermoides*, Pl. Wright. But by the same rule it must also comprise *G. Wrightii* Gray, Pl. Wright. 2, p. 78 (=*Xanthocephalum Wrightii*), and yet the line to draw between the two genera will not be perfectly clear.

GUTIERREZIA Lag. is held to comprise *Amphipappus* as well as *Amphiachyris*. The close relationship of the former with the latter is undoubted; but it is better to separate the two species from *Gutierrezia*, on account of the sterile disk, with almost if not quite setose pappus.

Amphiachyris dracunculoides Torr. & Gray, and *A. Fremontii* (*Amphipappus Fremontii* Torr. & Gray) constitute the species.

PENTACHÆTA Nutt. — *P. gracilis* Benth. in Ic. Pl. t. 1101, judging from the figure and description, cannot be of this genus. The style-branches, even if "not quite so obtuse as represented in the plate," altogether want the long linear-filiform appendage surmounting the short and flat stigmatiferous portion, and, with the opposite leaves toward the base of the stem (and, I may add, the beard represented on the lobes of the disk-corolla), as Mr. Bentham remarks, connect it technically, and it seems to me really, with *Helenioideæ*. It appears to be a species of *Oxypappus*.

As to *Pentachæta* itself, I find no bilabiation or obliquity in the disk-corollas, such as Nuttall mentions. And there are two species, which may be well distinguished, namely: —

PENTACHÆTA AUREA Nutt., from San Diego and the vicinity, has the heads perhaps always many-flowered (but the size of the head and number of the flowers varying greatly), and the scales of the involucre are acute or acuminate and well imbricated, the exterior successively shorter; the rays are golden yellow, and it is not known that the pappus is ever abortive.

PENTACHÆTA EXILIS (not a happy name for the larger forms) has the scales of the involucre less scarious, oblong or oval, obtuse, but often mucronate-tipped, all nearly equal in length; the rays very light yellow; pappus as in the original species, or in some specimens (mixed with the others) some or all of the bristles short or obsolete. This equally occurs in those with rather large and many-flowered and those with few-flowered heads. Either form may be rayless and homogamous. But some specimens have barely 3 to 5 pistillate flowers, which are destitute of ligule, the tube of the corolla only remaining. These are *Aphantochæta exilis*, Gray in Bot. Whippl. (Pacif. R. R. Expl. 4), t. 11, which must be viewed as an occasional and reduced state of a full-rayed species. It is only in the small and mostly rayless forms that the corollas seem to turn purplish.

XANTHISMA DC. It appears on the whole most proper to reinstate this genus, although a transition to *Aplopappus* is afforded by the section *Prionopsis*, which seemingly is best restricted, as proposed, to *A. ciliatus*. — The following is still more worthy of generic separation, and should be ranked rather with genera having paleaceous than with those of setose pappus.

ACAMPTOPAPPUS, Nov. Gen.

Capitulum homogamum, 12 – 30-florum. Involucrum hemisphæricum; squamis imbricatis triserialibus concavis appressis coriaceo-chartaceis obtusissimis margine scarioso eroso-fimbriolato limbatis sub apice macula viridula notatis cæterum albidis, extimis orbiculatis, intimis oblongis. Receptaculum subconvexum alveolatum, alveolis fimbrillatis. Corollæ infundibuliformes, limbo 5-lobo. Antheræ *Asterinearum.* Styli rami complanati, appendice triangulari-subulata hirtella terminati. Achenia turgido-turbinata, sericeo-villosissima (sub lana leviter 5-nervia). Pappus paleaceo-setosus, nempe, ex aristis setisve numerosis, 12 – 18 validioribus (achenio corollæque æquilongis) complanatis subclavellatis, cæteris brevioribus gracilioribus. — Suffrutex ramosissimus, angustifolius, glaber, capitulis subcorymbosis, floribus luteis.

A. SPHÆROCEPHALUS. *Aplopappus* (*Acamptopappus*) *sphærocephalus* Gray, Pl. Fendl. p. 76; Torr. in Pacif. R. R. Expl. 7, p. 12, t. 6.

LESSINGIA Cham. is a well-marked but very peculiar genus, which Mr. Bentham might perhaps have placed near to *Hinterhubera,* had he been aware that only the original species has yellow flowers. The other four are indeed homochromous, but cyanic, and also homogamous. Moreover, even *L. Germanorum* is not truly heterogamous; the anthers of the marginal flowers being present, and, I believe, commonly polleniferous. The flowers, at least in *L. leptoclada,* the only one I have seen in the living state, have a peculiar Centaurea-like aspect quite unlike anything Asteroideous; yet I should still maintain that it is more nearly related to *Corethrogyne* than to any other genus known to me. This relationship is manifested in the attenuated anther-tips, as well as in the style-branches, achenia, foliage, involucre, etc. From Bentham's notes: "Species 4 Californiæ Mexicique incolæ," and "Achænia glabra v. sericea," one may suppose that there is a Mexican species, still undescribed, which has glabrous achenia. These are silky-hairy in all the *five* described species.

APLOPAPPUS. No doubt the name should have been written *Haplopappus;* but as Cassini in founding the genus dropped the aspirate, and De Candolle followed him, it seems hardly necessary to go with Endlicher and Bentham in restoring it. The genus, like its analogue *Aster,* comprises very diverse forms, too intimately and variously connected to warrant the generic separations which have been attempted.

Like *Aster*, too, it has a few annual or biennial species, so that *Xanthisma* is not supported by this subsidiary character. Bentham makes *Aplopappus* include all the groups which I have referred to it, excepting Nuttall's *Ericameria* and *Macronema.* I have endeavored to adopt his view while now revising the North American species, but I find it impossible to do so. Neither the style-appendages (which are "long and narrow" in many an admitted North American species), nor the form and nature of the involucre and number of flowers it contains, nor the form of the achenia, nor the texture of the pappus, nor the habit, taken singly or in any practicable combination, enable me to draw any clear line of separation. Nor is the line which must be drawn for the demarcation of *Bigelovia* (*Chrysothamnus*) any less arbitrary when we have two bordering genera to deal with instead of one. One of Nuttall's species of *Macronema* closely connects *Ericameria* with other sections of *Aplopappus*, and the other with *Chrysothamnus;* while, as to *Chrysopsis*, a pretty well marked genus is rendered vague by the admission of species of a different habit and no external pappus.

It should be noted that Bentham's section *Haplodiscus* is not De Candolle's *Aplopappus* sect. *Aplodiscus*, the typical species of which is referred to *Bigelovia;* while the other proves to be a *Baccharis.*

Bentham's doubt whether *Aplopappus marginatus* Griseb. Cat. Pl. Cub. belongs to the genus, or has yellow rays, is well founded. Mr. Wright's tickets preserved here, as well as the one cited by Grisebach, state that the rays are white; and the plant is doubtless an *Aster* of the *Oxytripolium* section, allied to *A. Chapmanii* and *A. flexuosus* of Nuttall, i. e. *A. tenuifolius* Linn.

Recent collections have furnished the following additions to the *Ericameria* sections: —

APLOPAPPUS (ERICAMERIA) CUNEATUS. Fruticosus, ut videtur depressus, cæspitoso-ramosissimus, glaber, mox glutinosus; ramis floridis ad apicem usque foliosis; foliis cuneatis vel spathulato-dilatatis (apice lato truncato vel emarginato) integerrimis crassis resinoso-punctatis eveniis, costa vix prominula; capitulis subcorymbosis 20–24-floris; involucri turbinati squamis pluriseriatis lanceolatis carinato-uninerviis chartaceo-coriaceis, interioribus marginibus apiceque leviter scariosis disco brevioribus, exterioribus sensim brevioribus; ligulis circa 3 discum haud superantibus; appendicibus styli angustis parti stigmatiferæ æquilongis; acheniis lineari-oblongis compressis parce hirsutis; pappo parum rigido sordido. — California, in "Bear Valley, alt. 4,500

feet, Sept.," Kellogg, Bolander, etc.; no. 402 of Kellogg and Harford's distribution. — Heads half an inch long. Scales of the involucre more numerous, narrower, and less obtuse than those of *A. ericoides*. Achenia apprently broader and more decidedly compressed than in that species; the pappus similar. Leaves from a quarter to half an inch long, thick and rigid.* — A similar or perhaps the same species was collected in Arizona by Dr. E. Palmer in 1870, but without flowers.

APLOPAPPUS (ERICAMERIA) PINIFOLIUS. Fruticosus, 2 – 4-pedalis, glabratus, vix glutinosus; ramis fastigiatis usque ad capitulum solitarium foliosissimis; foliis fere acerosis (plerisque pollicaribus) pl. m. punctatis; involucro campanulato foliis summis capitulum adæquantibus vel superantibus involucrato, squamis propriis ovato- vel oblongo-lanceolatis acuminatis coriaceis rigidis, margine tantum scarioso; ligulis circiter 20 brevibus angustis; appendicibus styli filiformibus parte stigmatifera brevioribus; ovariis linearibus fere glabris; pappo rigidiusculo albo. — Near Los Angeles, in a dry river-bed, Bolander, 1873. — The leaves most resemble those of *A. laricifolius*, but are still more narrow, or those of *Bigelovia arborescens*. Head always solitary at the summit of a very leafy branch, about four lines high. Most of them in the few specimens received are abnormal, having chaff on the receptacle, and the flowers they subtend often pistillate and ligulate, instead of hermaphrodite and tubular: others are in a normal condition.

APLOPAPPUS (ERICAMERIA) BLOOMERI, Gray. To this, and not to Nuttall's *Ericameria resinosa*, belongs the plant figured in the Botany of Wilkes's Expedition, plate 10, under the name of "*Aplopappus resinosus*."

NARDOPHYLLUM GENISTOIDES, *Dolichogyne genistoides* Philippi in Linnæa, 28, p. 738. This striking species occurs in the collection of the United States Pacific Exploring Expedition under Wilkes, with no ticket indicating habitat. It is now evident that it must have been gathered in the Andes near Santiago, Chili. The specimens have lanceolate (rather than oblong-linear) leaves, with a cuspidate tip, and the heads are fully an inch long. Bristles of the pappus conspicuously barbellate towards the summit.

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* All the flowers of one head exhibited a singular monstrosity of the corolla, namely, five or sometimes three or four ligulate lobes outside of the ordinary lobes, and inserted on the middle of the tube, forming an accessory circle of parts, equalling in length the true corolla.

CHRYSOTHAMNUS, Nutt. This is the name adopted in the Genera Plantarum for the group containing not only the *Chrysothamnus* of Nuttall, and all the species which I have at various times generically combined with it under the name of *Linosyris* (Schlechtendal having led the way with a Mexican species), but also *Bigelovia* DC., as restricted in Torr. & Gray's Flora. All this consolidation is evidently necessary, as also the separation of these American species from *Linosyris* of the Old World, the species of which, by the occasional production of heterochromous rays, are now proved to belong to *Galatella*, i. e. to *Aster* in the largest sense. But *Chrysothamnus* is a much later name than *Bigelovia*, which, as Bentham cursorily indicates in the appendix, is to be adopted. The genus, as now received, is nearly as polymorphous or composite as *Aplopappus* itself, from which at more than one point it is quite arbitrarily separated. On the other hand, it is as arbitrarily distinguished from the *Euthamia* subgenus of *Solidago*, *B. diffusa* and *B. arborescens* sometimes developing a small ray or two. As these species have lanceolate or even broader style-appendages, achenia which are not very slender and taper to the base, and ampliate rather deeply cleft limb to the corolla, we have to rely upon the unequal bristles of the pappus and the woody habit to keep them out of *Solidago*. The typical *Bigelovia* and all the genuine *Chrysothamni* partake of the character which is so strikingly displayed in *B. pulchella*, *Bigelovii*, and *depressa*, namely, the imbrication of the scales of the involucre in five (rarely four) strict vertical ranks. The slender style-appendages of *Ericameria* also characterize the section *Chrysothamnus* and another group which lies between the two; while the original *Bigelovia* has the style as well as the habit of *Solidago*, section *Euthamia*. The cusp in the centre of the receptacle of *B. nudata* occurs (sometimes in a more chaffy form) in the original specimens of *B. Bigelovii*, also in those recently received from Mr. Greene, but not in those collected by Dr. Parry; and it is represented by some chaff-like extensions of the alveoli in *B. Bolanderi*, as also by the setiform elongated frimbrillæ in *B. diffusa*. The achenia are at least 5-nerved in almost all the species; several have intermediate, usually more slender nerves.

In the subjoined revision, the first section ends with species which are ambiguous between *Bigelovia* and *Solidago*, and the whole with the better characterized but very Solidagineous original species.

BIGELOVIA DC. excl. § 3. (*Chrysothamnus* Nutt., Benth. & Hook. Gen. Pl. 2, p. 255.)

§ 1. Diplostephioides Benth. & Hook. Involucrum pluriflorum, cylindraceum; squamis siccis latis obtusis spiraliter imbricatis: corollæ limbus 5-partitus! lobis linearibus: appendices styli lanceolatæ parte stigmatica breviores: achenia linearia. Frutices vel arbusculæ Andinæ, habitu alieno: folia lanceolata penninervia subtus tomentosa: capitula amplius corymbosa.

1. B. hypoleuca., *Aplopappus hypoleucus* Turcz. in Bull. Mosc. 1851, p. 177. *Linosyris Mandonii* Schult. Bip.

2. B. fuliginea *Baccharis fuliginea* HBK., ex Benth.

§ 2. Aplodiscus. Involucrum pluri-multiflorum campanulatum vel turbinatum, in penultimis paucifloris angustum; squamis spiraliter imbricatis, i. e. seriebus verticalibus haud conspicuis: corollæ limbus 5-lobus: appendices styli aut triangulari-ovatæ aut subulato-lanceolatæ parte stigmatica breviores: achenia breviuscula.

* *Aplopappoideæ*, foliis sæpius dentatis lobatisve; involucri squamis apice herbaceo notatis.

3. B. veneta. *Baccharis veneta* HBK. Nov. Gen. & Sp. 4, p. 68. *Aplopappus* (*Aplodiscus*) *discoideus* DC. Prodr. 5, p. 350. *Linosyris Mexicana*, Schlecht. Hort. Hal. p. 7, t. 4. — Mexico: approaches the borders of the United States, but apparently not found within.

4. B. Menziesii. Foliis oblanceolatis spathulatisve rigidis parce argute dentatis nunc pinnatilobatis; capitulis pauciusculis glomeratis; involucri 12–20-flori squamis obtusis; acheniis fere linearibus subcompressis. — *Pyrrocoma Menziesii* Hook. & Arn. *Aplopappus* (*Aplodiscus*) *Menziesii* Torr. & Gray. *Linosyris dentata* Kellogg, Proc. Calif. Acad. 2, p. 16? — California to Arizona. Very near the foregoing, and probably passes into it. The most tangible differences are that the scales of the involucre in *B. veneta* are more or less acute, and the achenia shorter and turbinate.

5. B. coronopifolia. Ramis gracilioribus; foliis punctatis pinnato-3–7-partitis, segmentis (setaceo-mucronatis) rhachique angusto-linearibus nunc fere filiformibus; capitulis pauciusculis glomeratis; involucri 10–12-flori squamis obtusis; acheniis subturbinatis. —*Linosyris coronopifolia* Gray, Pl. Wright. 1, p. 96. — Texas, and along the

Rio Grande to Southern Arizona (E. Palmer). Dr. Palmer's plant, with rather shorter and broader lobes and rhachis to the leaves, approaches no. 114 of Hartweg's Mexican collection, which probably belongs here.

6. B. DRUMMONDII. Suffrutescens, glaber; foliis obsolete punctatis linearibus basi attenuatis crassiusculis integerrimis; capitulis laxius corymbosis; involucri 20-30-flori squamis obtusis coriaceis apice virido, marginibus vix scariosis; acheniis linearibus subcompressis. — *Linosyris Drummondii* Torr. & Gray, l. c. — Texas, near the coast, from Indianola to the Rio Grande.

* * *Euthamioideæ*, capitulis numerosiorbus minoribus, involucri squamis apice vel costa minus parumve viridulis vel concoloribus.

+- Folia lanceolata vel linearia: capitula conferte corymbosa lin. 4-5 longa.

7. B. WRIGHTII. Suffruticosa, glabra, glabrata, vel hirtello-scabra; ramis e basi lignescente erectis 1-2-pedalibus virgatis; foliis linearibus uninerviis vix punctatis mucronatis aut integerrimis aut inferioribus hinc inde laciniato-dentatis; corymbis polycephalis; involucro 7-14-floro glabro disco dimidio breviore; squamis oblongis ovalibusque obtusis margine angustissime scariosis apice pl. m. viridulis; acheniis turbinatis brevibus sericeis. — *Linosyris Wrightii*, *heterophylla*, & *hirtella* Gray, Pl. Wright, 1, p. 95. — Southwestern Texas, on the Rio Grande and its tributaries, to the Gila, Arizona (Sutton Hayes). It varies considerably, and is not unlikely to pass into the next.

8. B. PLURIFLORA. Præcedenti similis; foliis anguste linearibus; capitulis parum majoribus; involucri 15-18-flori squamis lanceolatis acutis vel acutiusculis concoloribus. — *Linosyris pluriflora* Torr. & Gray, Fl. 2, p. 233. — Collected only by Dr. James in Long's Expedition, probably on the South Fork of the Platte.

9. B. LANCEOLATA. Fruticosa, puberula; foliis lineari-lanceolatis trinerviis scabrido-puberulis integerrimis mucronatis; corymbis polycephalis confertis; involucro 6-8-floro disco parum breviore, squamis oblongis, interioribus obtusis albidis, exterioribus brevibus subacutis farinoso-puberulis; appendicibus styli angusto-lanceolatis. — *Chrysothamnus lanceolatus* Nutt. l. c. *Linosyris lanceolata* Torr. & Gray, l. c. — Rocky Mountains, near the sources of the North Fork of the Platte, Nuttall, by whom only as yet has this well-marked species been collected.

+- +- Folia angustissime linearia vel filiformia: capitula (lin. 3 longa) vel corymbuli sæpius paniculati.

10. B. Cooperi. Glabra, crebre punctata, glutinosa, fruticosa vel fruticulosa; foliis (ramealibus) lin. 3 – 4 longis lineari-filiformibus subcrassis obtusis; capitulis corymbulosis; involucro 6 – 7-floro, squamis 12 – 14 ovalibus oblongisque chartaceis omnino pallidis, intimis acutiusculis; corollæ limbo breviter 5-lobo; appendicibus styli deltoideo-ovatis parte stigmatica dimidio brevioribus; acheniis turbinatis sericeo-villosis æqualiter 10-costatis. — Southeastern California, on the eastern slope of Providence Mountain, Dr. J. G. Cooper.

11. B. diffusa. Glabra, parum glutinosa, obsolete punctata, basi fruticosa, diffuse ramosissima; ramis gracillimis; foliis (sub-semipollicaribus) fere filiformibus subcanaliculatis apice sæpe recurvis; capitulis glomerulisve 2 – 4-cephalis laxius paniculatis; involucro 5 – 8-floro, squamis 10 – 12 ovalibus oblongisque obtusissimis subcoriaceis margine tenuiter scariosis, apice pl. m. viridulo; corollæ limbo profunde 5-fido, lobis lineari-oblongis; appendicibus styli subovatis obtusis parte stigmatica multo brevioribus; acheniis lineari-turbinatis sericeo-hirsutulis 5-costatis; receptaculo ex alveolis intimis in paleolas aristiformes achenia subsuperantes producto: flores 1 – 2 marginales quandoque imperfecte ligulati. — *Ericameria diffusa* Benth. Bot. Sulph. p. 23. *Solidago* (*Euthamia*) *diffusa* Gray, Proc. Am. Acad. 5, p. 159. *Linosyris Sonoriensis* Gray, l. c. 8, p. 291; stylus perperam descr. — Cape San Lucas, in Lower California, Hinds, Xantus. Yaqui River (probably Yaqua River on the eastern side of the Gulf), Dr. E. Palmer.

12. B. arborescens. Glabra, resinoso-punctata, glutinosa; ramis e caule arboriformi 3 – 6-pedali erectis confertis scopariis foliosissimis; foliis (2 – 4-pollicaribus) angustissime linearibus demum marginibus revolutis filiformibus; corymbis conferte polycephalis paniculatis; involucro 20 – 25-floro discum subæquante; squamis pluriseriatis lanceolatis acutis tenuiter puberulis, carina tantum viridulo; appendicibus styli lanceolato-subulatis parte stigmatica parum brevioribus; acheniis brevibus turbinatis sericeo-pubescentibus 5-costatis: flores extimi raro ligulati. — *Linosyris arborescens* Gray in Bot. Mex. Bound. p. 79. — California, on dry ridges of the coast range, Santa Cruz to Tamalpais. Specimens collected by Professor Brewer above Santa Cruz show an attempt to produce a series of small ray-flowers: this, if at all normal, would remand this species to the *Euthamia* section of *Solidago*,

which it resembles, except in the woody stem, and the unequal more copious bristles of the pappus. The alveoli of the receptacle are produced into subulate teeth.

§ 3. CHRYSOTHAMNOPSIS. Involucrum 5–15-florum, cylindraceum; squamis lanceolatis acuminatis siccis (plerumque chartaceis nec herbaceo appendiculatis vel notatis) spiraliter imbricatis: corollæ limbus angusto-infundibuliformis breviter 5-lobus: appendices styli subutato-filiformes *Chrysothamni:* achenia angusta, elongata, sericeo-pubescentia: pappi setæ tenues, subæquales: folia angusta, subtrinervia, integerrima. (Transitus ad *Aplopappum* per *A. Macronema.*)

13. B. BOLANDERI. Suffruticosa, humilis, subviscosa; ramis lana valde implexa adpressissima dealbatis; foliis spathulato-linearibus ob-lanceolatisve acutatis haud rigidis (circiter pollicaribus); capitulis subcorymboso- vel subracemoso-congestis plerisque folio seu bractea folioso stipatis; involucro 7–11-floro; squamis circa 10 lanceolatis sensim acuminatis nudis: alveoli receptaculi paleaceo-dentiformibus. — *Linosyris Bolanderi* Gray, Proc. Am. Acad. 7, p. 354. — Mono Pass in the Sierra Nevada, California. The narrow heads are three quarters of an inch long. This species is so obviously and closely related to *Aplopappus Macronema* (*Macronema discoidea* Nutt.), that it might be better to refer that plant to this genus, the line, wherever drawn, being almost arbitrary. Bolander found both at Mono Pass, and at nearly the same elevation.

14. B. HOWARDII. Suffruticosa, humilis, ramosissima, pl. m. lanata, mox glabrescens; foliis linearibus rigidis (1–2-pollicaribus) uninerviis, superioribus capitula pauciuscula subcongesta fulcrantibus paulloque superantibus; involucro 5-floro, squamis 12–15 oblongo-lanceolatis primum arachnoideis aut sensim aut extimis subito caudato-acuminatis; corollæ tubo parce villosulo. — *Linosyris Howardii* Parry in Proc. Am. Acad. 6, p. 541. — Var. NEVADENSIS. Rigidior; foliis latioribus sursum pl. m. dilatatis nunc obsolete trinerviis; involucri magis arachnoidei subviscosi squamis subcoriaceis, siccis apice recurvis. — *L. Howardii* var. *Nevadensis* Gray, l. c. — Gravelly soil in the "parks" of Colorado, extending to the Sierra Nevada, where it is chiefly the var. *Nevadensis.* Receptacle paleaceous-dentate, almost as in the preceding. The scales of the involucre, more numerous than in the preced-

ing and following species, are disposed to form 4 or 5 vertical ranks, in the manner of the next section.

15. B. PARRYI. Suffrutescens, spithamæa ad pedalem, primum sublanata, mox glabrata; ramis tantum tenuiter lanato-dealbatis virgatis ad apicem usque foliosis; foliis linearibus (2 – 4 poll. longis lin. 1 – 2 latis) basi attenuatis plerisque trinerviis; capitulis in thyrsum angustum vel spiciformem foliosum congestis foliis fulcrantibus plerumque longius superatis; involucro 10 – 15-floro, squamis lanceolatis attenuato-acuminatis pauciseriatis nudis, extimis bracteantibus sæpius folioso-appendiculatis; corollæ tubo hirsutulo. — *Linosyris Parryi* Gray in Proc. Acad. Philad. 1863, p. 66. — Rocky Mountains of Colorado in the region of South and Middle Park. Heads rather numerous, shorter than in the two foregoing, only 6 to 8 lines long. Alveoli of the receptacle short and nearly entire.

§ 4. CHRYSOTHAMNUS. (*Chrysothamnus* Nutt. excl. sp.) Involucrum 5-florum, angustum; squamis siccis carinatis pentastichis (raro tetrastichis), nempe in seriebus verticalibus strictis 5 (rarius 4) imbricatis: corollæ limbus angustus aut breviter aut profundius 5-lobus: appendices styli elongato-subulatæ vel filiformes hispidulæ, parte stigmatica lineari sæpius longiores: achenia angusta, linearia: pappi setæ tenues: folia angusta integerrima.

* Achenia glaberrima, 4 – 6-angulata, disco epigyno lato: involucri squamæ acuminatæ eximie pentastichæ, in utraque seriei verticali 5 – 6: capitula majuscula (ultra semipollicem longa), corymbuloso-conferta: corollæ lobi breves: pappus corolla longior.

+ Frutices ramosissimi ultrabipedales, ramis rigidis gracilibus scopariis.

16. B. BIGELOVII. Subcinerea; ramis junioribus dealbatis; foliis marginibus revolutis filiformibus; involucri squamis chartaceis concoloribus modice carinatis appressis, exterioribus oblongo-lanceolatis lanoso-ciliatis acutiusculis, interioribus angustioribus plerumque acuminatis; pappi setis vix rigidulis. — *Linosyris Bigelovii* Gray in Bot. Whippl. p. 42, t. 12. — Above Albuquerque, New Mexico, Dr. J. M. Bigelow, and probably at a station farther north, Dr. Parry: Huefano plains, Colorado Territory, E. L. Greene. Notwithstanding the iteration, no objection will be taken, I trust, to continuing the dedication of

this species to its discoverer, Dr. J. M. Bigelow, because the genus was named for the veteran botanist Dr. Jacob Bigelow.

17. B. PULCHELLA. Undique glabra; foliis viridibus anguste linearibus uninerviis margine nunc serrulato-scabris, ramealibus subulatis; involucri squamis lanceolatis acutatis eximie carinatis fere coriaceis apice viridibus; pappi setis rigidulis. — *Linosyris pulchella* Gray, Pl. Wright. 1, p. 96, & Bot. Whippl. p. 43; Torr. in Sitgreaves' Rep. t. 4. — New Mexico, near the Rio Grande, etc. Heads nearly three quarters of an inch when in fruit and the pappus well developed, somewhat the largest of this section.

+ + Fruticulosa, ramis spithamæis simplicioribus e basi decumbente.

18. B. DEPRESSA. Glabra, scabrido-cæsia; foliis lanceolatis seu oblanceolatis mucronato-acutis brevibus (semipollicaribus) rigidis; involucri squamis elongato-lanceolatis sensim acuminatis lævibus chartaceis concoloribus; pappi setis rigidulis. — *Chrysothamnus depressus* Nutt. Pl. Gamb. p. 171. *Linosyris depressa* Torr. in Sitgreaves' Rep. p. 161. Mountains of the northern part of New Mexico: not "in the sierra of Upper California, as stated by Nuttall: Dr. Gambell's specimen is ticketed "Rocky Mountains." Dr. Parry collected it in 1867 in the Sangre de Christo Mountains, and recently Mrs. A. P. Thompson sent it from Kanab, Utah. Heads few in a terminal cluster, 8 lines long when fully developed.

* * Achenia sericeo-pubescentia: capitula numerosa, minora (haud ultra semipollicaria): involucri squamæ minus numerosa: pappus corollam raro adæquans.

+ Involucri squamæ caudato-acuminatæ.

19. B. CERUMINOSA. Fruticosa, fastigiato-ramosissima, bi-tripedalis, tenuissime lanuginosa, mox glabrata sæpeque resinoso-glutinosa; foliis filiformibus vel angustissime linearibus marginibus involutis, ramealibus sæpius hamato-recurvis; capitulis corymbuloso-fasciculatis; involucro glutinoso, squamis lanceolatis carinatis præter carinam viridulam in acumen aristiforme recurvum eximie productam pallidis; corollæ lobis lineari-lanceolatis; pappo haud copioso. — *Linosyris ceruminosa* Durand & Hilgard in Jour. Acad. Philad. n. ser. 3 (Pl. Heerm.) p. 40, & Pacif. R. R. Exped. 5, p. 9, t. 6. — Interior of California, at Tejon Pass, Dr. Heermann.

+ + Involucri squamæ apice obtuso incrassato viridi.

20. B. TERETIFOLIA. Fruticosa, subpedalis, ramosissima, glabra resinoso-glutinosa; ramis rigidis brevibus fastigiato-corymbosis; foliis filiformibus sursum sæpius crassioribus obtusis (semi–subpollicaribus) creberrime punctatis primum pruinoso-cæsiis mox vernicosis; capitulis subspicato-confertis; involucro angustissimo, squamis pallidis ad apicem parvum viridulum sæpius glanduligeris, interioribus oblongo-linearibus, extimis sensim ad bracteolas breves reductis; corollæ lobis brevissimis; pappo haud copioso. — *Linosyris teretifolia*, Durand & Hilgard, l. c. t. 7. California, on the mountains around Tejon Valley, Dr. Heermann; Arizona at Union Pass, Dr. E. Palmer (without flowers). Heads 5 or 6 lines long.

+ + + Involucri squamæ nec acuminatæ, nec apice viridulo notatæ, pauciusculæ, nempe in utraque seriei 3 – 4.

++ Folia resinoso-punctata, angustissima: capitula paniculata.

21. B. PANICULATA. Fruticosa? pruinoso-subcinerea vel glabra; foliis ramealibus lineari-filiformibus (vix semipollicaribus), summis brevissimis subulatis ramulisque resinoso-punctatis; capitulis laxiuscule paniculatis; involucri squamis oblongis obtusis tenuibus omnino pallidis minus carinatis, intimis achenia linearia vix superantibus; corollæ limbo ad medium usque 5-lobo; appendicibus styli subulato-filiformibus parte stigmatica duplo longioribus; pappo molli. — *Linosyris viscidiflora* var. *paniculata* Gray in Bot. Mex. Bound., p. 80. "California," Schott, probably in the southeastern part of the State: the station not recorded, and the specimen incomplete.

++ ++ Folia impunctata, angustiora uninervia, latiora trinervia: capitula corymboso- nunc subthyrsoideo-congesta.

22. B. GRAVEOLENS. Fruticosa, 1 – 4-pedalis, primum pl. m. lanata, tomento nunc copiosô implexo derasibili nunc tenui evanescente; ramis virgatis; foliis aut angustissime linearibus mox involutis aut latioribus planis; capitulis semipollicaribus; involucri squamis oblongis vel lanceolatis obtusiusculis vel obtusis; corollæ limbo breviter 5-lobo; appendicibus styli subulato-filiformibus parte stigmatica longioribus; pappo satis molli. — *B. dracunculoides* & *B. Missouriensis* DC. Prodr. 5, p. 329. *Chrysocoma dracunculoides* (non Lam.) & *nauseosa* Pursh. *C. graveolens* & *nauseosa* Nutt. Gen. *Chrysothamnus dracunculoides* & *speciosus* Nutt. Trans. Amer. Phil. Soc. *Linosyris graveolens* & *albicaulis* Torr. & Gray, Fl. 2, p. 234. — Plains, etc., Western Arkansas to Dakota, and west to California and Washington Territory. — Exhibits

numerous inseparable forms, of which the most marked deviations from the general type are: —

Var. GLABRATA. (*Linosyris graveolens* var. *glabrata* Engelm.) Primum tomento tenui cinerea, mox glabrata viridis; involucri squamis sæpius angustioribus subacutis; corollæ lobis paullo longioribus.

Var. LATISQUAMEA. Involucri squamis latioribus obtusissimis; corollæ lobis brevissimis. — New Mexico, Dr. Bigelow, Dr. Henry. Inner scales papery and glabrous. the short outer ones tomentose.

Var. HOLOLEUCA. Undique cano-tomentosa, involucri squamis angustis obtusissimis; corollæ lobis brevissimis, tubo pilis parcis longis arachnoideis instructo. — Owens's Valley, interior of California, Dr. Horn. (No. 2852, distrib. Brewer.)

Var. ALBICAULIS. Caule dense lanato; foliis glabrescentibus; involucri squamis glabris obtusiusculis; corollæ lobis longiusculis, tubo pilis crebris longis arachnoideis villoso. — *Chrysothamnus speciosus* var. *albicaulis* Nutt. l. c. *Linosyris albicaulis* Torr. & Gray, l. c. — Rocky Mountains, Nuttall, Burke. In most flowers of the species there is a variable amount of short and stronger hairs on the tube of the corolla. In this they are peculiar for their length and cobwebby character. Traces of the same I have now met with in some different forms, notably in the preceding. The form of the corolla-lobes also varies unconformably with other characters, being in some no longer than broad, in others twice or thrice longer.

23. B. DOUGLASII. Fruticosa, subpedalis ad orgyalem, fastigiato-ramosa, glabra vel scabro-puberula (nunquam lanosa); foliis aut angustissime aut latiuscule linearibus lanceolatisve rigidulis; capitulis lin. 4 – 5 longis conferte cymosis; involucri squamis oblongis seu latiuscule linearibus obtusis; corollæ limbo ad medium usque 5-lobo; appendicibus styli angusto-subulatis parte stigmatica dimidio brevioribus; acheniis breviusculis deorsum angustatis; pappo satis rigidulo. — *Crinitaria viscidiflora* Hook. Fl. Bor.-Am. 2, p. 24. *Chrysothamnus viscidiflorus* & *pumilus* Nutt. l. c. *Bigelovia viscidiflora* DC. Prodr. 7, p. 279. *Linosyris viscidiflora* Torr. & Gray, l. c. — Colorado Territory and Wyoming to the Sierra Nevada, California, Oregon, and Washington Territory. In referring it back to *Bigelovia*, I venture to give a new specific name for this widespread species, the original one being misleading. For, although the involucre may occasionally be viscid with a resinous or balsamic exudation, it appears to be more generally free from it than any other species of the section; and the

flowers seem never to be viscid. Nor is Nuttall's name much more appropriate for a species which, though commonly low, is occasionally six feet high. It exhibits several but obviously confluent varieties, of which the following represent the extreme forms: —

Var. STENOPHYLLA; with very narrowly linear leaves, half a line wide. Northwestern Nevada, S. Watson in King's Expl.

Var. LATIFOLIA (*Linosyris viscidiflora* var. *latifolia* Eaton in Bot. King, p. 157), with oblong leaves 1 – 1½ inches long and half an inch wide. Northwestern Nevada, S. Watson. These two are glabrous forms.

Var. SERRULATA (*Linosyris serrulata* Torr. in Stansb. Rep.) has the margins of the leaves ciliate or as if serrulate with rigid, short bristles; otherwise glabrous or nearly so. A common form in the interior dry region.

Var. TORTIFOLIA; like the preceding, but the leaves twisted remarkably. Sierra Nevada, California, Brewer; Mt. Davidson, Nevada, Bloomer.

Var. PUBERULA (*Chrysothamnus pumilus* Nutt., pro parte. *Linosyris viscidiflora* var. *puberula* Eaton, Bot. King); with leaves, branches, etc., pulverulently or almost hispidly puberulent. Not rare in the interior districts.

§ 5. EUBIGELOVIA. (*Bigelowiæ genuinæ* DC.) Involucrum 3–4-florum, angustum; squamis paucis siccis flavidis oblongo-linearibus obtusis carinatis pentastichis vel subtetrastichis in utraque seriei 2–3: receptaculum parvum, alveolis subulato-dentiformibus, in centro longe cuspidatum: corollæ limbus ampliatus 5-fidus: appendices styli ovato-subulatæ, parte stigmatica breviuscula breviores: achenia brevia subturbinata: pappi setæ pauciusculæ, rigidulæ.

24. B. NUDATA DC. Mem. Comp. t. 5, & Prodr. 5, p. 329. Forma *spathulæfolia*, Torr. & Gray, l. c., &

Var. VIRGATA Torr & Gray, l. c. *B. virgata* DC. — Pine barrens in damp soil. Texas to New Jersey, near the coast.*

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* *Species Exclusæ.*

Linosyris squamata Gray in Proc. Am. Acad. 8, p. 290, is a *Senecionea.*

L. Texana Torr. & Gray Fl., is *Baccharis Texana* Gray, Pl. Fendl. p. 75.

L.? humilis Torr. & Gray, l. c. (*Crinitaria humilis* Hook.), is *Brachyactis.*

L. ramulosa Gray, Pl. Wright., is *Baccharis ramulosa* Gray, Pl. Thurb. p. 301.

L. carnosa Gray, Pl. Wright., 2, p. 80, is most probably an *Aster* of the *Oxytripolium* section, without rays.

ASTER. We should receive the genus in all the extent it now reassumes, *Machæranthera* included, although that on the whole well bears separation, as does *Diplopappus* section *Triplopappus*. But the separation of Nuttall's *Dieteria* from the section *Machæranthera* and its reference to *Euaster* does not seem to be called for. The general biennial or even annual character, which is foreign to true *Aster*, as well as the tendency to pinnatifid or incised leaves, belongs to both alike; the style-appendages are narrow in both; and the achenium of *Dieteria*, equally with that of *Machæranthera*, has several slender nerves on the faces, as well as a strong rib on each margin. I may here append the note, that —

ASTER TENUIFOLIUS Linn., as the Linnæan herbarium shows, and the character confirms, is founded on the plant known as *A. flexuosus* Nutt. To this alone (and not to Plukenet's plant) the phrase "pedunculis foliolosis" and the added descriptive notes relate.

ASTER SUBULATUS Michx. is truly the name to be preserved for our common northern maritime *Oxytripolium*, the original *A. linifolius* of Linnæus (Hort. Cliff. etc.) being really a *Galatella*.

ASTER ARENARIOIDES D. C. Eaton, in herb., is the name which should be borne by the plant described and figured as *Erigeron stenophyllum* Eaton in Bot. King, p. 152, t. 17 (not *E. stenophyllum* Gray, Pl. Fendl.), a species which most resembles *A. pauciflorus* Nutt. in its more slender form, but has only 2-nerved ovaries, a different glandulosity, etc. The akenes of *A. pauciflorus* are delicately 8 – 10-nerved. Bentham's character of *Oxytripolium* needs extending in this respect on account of more than one species.

BRACHYACTIS Ledeb. On the whole it seems clearly preferable to adopt this genus; but, as extended by Mr. Bentham, it includes two types, of somewhat different affinities. The original *B. ciliata* has lanceolate-subulate style-appendages, narrow and rather turgid achenia, with a large epigynous disk and marginal nerves rather inconspicuous, and a simple pappus of copious equal bristles. To this, as I long ago observed, belongs *Tripolium angustum* Lindl. But I confounded with it a second species, of more southern range, which Mr. Bentham has now distinguished (as var. *carnosula*, in Hook. Ic. sub 1106), and which has not only broader and more foliaceous involucral scales, but also distinct (purple) ligules much exceeding the style. As this must be Nuttall's *Tripolium frondosum*, although his specimens are too young to show it clearly, it may take the name of B. FRONDOSA. These two species were not unnaturally associated with *Aster* (*Oxytripolium*) *linifolius*, or rather *subulatus*.

Of the other species referred to the genus, I have had only *B. robusta* Benth. and the figure of *B. menthodora* to examine. The former is more conyzoid in the involucre, as well as in the small number of hermaphrodite flowers, has broad and obtuse style-appendages (as those of *B. menthodora* are represented), broader and flat achenia with prominent marginal ribs, and a pappus of two distinct sorts of bristles, those of the outer set not longer than the width of the achenium.

BOLTONIA L'Her. is made by Bentham to include my *Dichætophora;* but the Californian species referred to it (p. 209) proves to be *Perityle Acmella* of Pl. Fendl.

ERIGERON Linn. is maintained in the wide sense to which we are here accustomed. For our section *Stenactis*, Nuttall's name *Phænactis* is preferred, because Cassini's name was misapplied by Nees and by De Candolle, and both the original *Stenactis* (*Polyactis* Less.) and the leading one of Nees and De Candolle fall into *Phalacroloma*. That leaves the name free for the employment that was made of it; yet it is right and clearer to keep up Nuttall's sectional name. But the section itself does not very well hold out. As to *Woodvillæa*, the conjecture that it is *E. glaucum* was long ago positively confirmed.

E. ARMERIÆFOLIUM Turcz., in an authentic Siberian specimen examined, wholly wants the internal filiform pistillate flowers (De Candolle's and Turczaninow's remark which implies the contrary notwithstanding); and to it clearly belongs *E. glabratum* var. *minor* Hook. (a large form of which must be *E. lonchophyllum* Hook.), and *E. racemosum* Nutt., at least in part, — a species which is not uncommon in the Colorado Rocky Mountains and the Sierra Nevada. Hall and Harbour's 232 is a large form of it.

E. BELLIDIASTRUM Nutt. Some careless determinations of mine, confounding this with the very similar *E. divergens*, have misled Professor Eaton into altering the character of the species by assigning to it the double pappus of the latter. It has a simple and wholly deciduous pappus, and its achenium is tipped with a broad and white epigynous disk. Hall and Harbour's 246, Hall's Oregon 249, and the *E. Bellidiastrum* of Bot. King, p. 150, all belong to *E. divergens*. Besides the pappus, the receptacle in the more northern specimens of *E. divergens* is strongly convex. It is less or slightly so in some forms, especially in *E. cinereum* Gray, Pl. Fendl., which on the whole I cannot specifically distinguish. But *E. flagellare* Gray l. c. is perennial, at least by its stolons, and quite distinct.

E. URSINUM Eaton, in Bot. King, l. c., needs to be compared with *E. radicatum* Hook.

E. CÆSPITOSUM Nutt., a considerably leafy-stemmed species, more or less canescent, with a fine and chiefly spreading roughish pubescence, its leaves rather short, style-appendages extremely short and obtuse, minutely hairy akenes 2-nerved, or rarely 3-nerved, and the outer short pappus squamellate and conspicuous, has been more or less confounded with some other pretty well marked species, such as

E. NEVADENSE. Pube tenui appressa substrigosa pl. m. cinerea; caulibus e rhizomate elongato repente adscendentibus vel erectis; floridis scapiformibus vel apice nudis monocephalis 4 – 9-pollicaribus; foliis lineari-lanceolatis vel spathulato-linearibus integerrimis, imis elongatis (2 – 6-poll.) in petiolum attenuatis, caulinis acutis, summis ad bracteas subulatas diminutis; involucri squamis æqualibus hirsutis subglandulosisque (lin. 4 longis); ligulis 25 – 30 latiuscule linearibus albis (lin. 3 – 4 longis) uniseriatis; appendicibus styli ovatis acutis nunc acutissimis; acheniis oblongis pubescentibus ad margines tantum nervatis (seu radii 3-nervatis); pappo exteriore parco setuloso. — *E. cæspitosum* var. *grandiflorum* Eaton in Bot. King, p. 153, pro parte, nempe, no. 548, non Torr. & Gray. — Sierra Nevada, on the borders of the State of Nevada: near Virginia City, Bloomer; Mount Stanford, etc., Bolander, Kellogg; W. Humboldt Mountains, S. Watson.

Var.? PYGMÆUM: foliis plerisque in caudice crasso confertis angusto-spathulato-linearibus (raro pollicaribus); scapis 1 – 3-pollicaribus; capitulo dimidio minore; involucro minus hirsuto; ligulis purpureis. — Above Ebbett's and at Mono Pass, California, alt. 9,500 to 10,750 feet, Brewer. Very likely a distinct species.

E. ARGENTATUM. Pube brevi molli adpressissima sericeo-incanum; caulibus e rhizomate (ut videter repente?) erectis (spithamæis ad pedalem) simplicibus apice nudo monocephalis; foliis linearibus, imisve angusto-spathulatis in petiolum attenuatis, summis sparsis subulatis; involucri (lin. 4 alti) squamis lineari-lanceolatis, exterioribus brevioribus atque caulis canescentibus; ligulis plus 50 latiuscule linearibus albis (fere semipollicaribus); appendicibus styli brevissimis obtusissimis; acheniis (potius ovariis) crebre villosis 6 – 10-*nerviis;* pappo duplici, utroque copioso, exteriori squamellato-setoso interiore $\frac{2}{3}$ breviori. — *E. cæspitosum* Eaton, Bot. King, l. c. pro parte, nempe, no.

549. — Nevada, in the Pah-Ute Mountains, Ruby Valley, etc., alt. 5,000 to 6,000 feet, S. Watson. Pahranagat Mountains, Southeastern Nevada, Miss Searls.

E. CANUM Gray, Pl. Fendl., is well marked by its perfectly glabrous, narrow, conspicuously about 10-ribbed akenes. The pubescence, which is seldom as silvery as in the preceding, is somewhat strigose, and on the involucre loose or hirsute; the heads only half as large as those of *E. argentatum;* the rays narrower; style-appendages equally short and obtuse. This species proves to be more abundant than was supposed, I having confounded it with *E. cæspitosum.* New Mexico, Fendler, 375; Parry, 83 and 88 of coll. 1867. Wyoming, on the Platte, Geyer, 30, in part (the rest being *E. pumilum*). Colorado Territory, Hall and Harbour, no. 244, wrongly referred to *E. cæspitosum.*

E. STENOPHYLLUM Gray, in Bot. Whippl. p. 42 (98), from New Mexico, Dr. Bigelow, has achenia villous with long soft hairs and only marginal nerves, obtuse style-appendages, and a very copious simple pappus. The proper tube of the corolla in the disk is very short, the cylindrical throat sparsely villous.

Var.? TETRAPLEURUM has smaller heads and flowers, and mostly 4-nerved, rarely 2-3-nerved ovaries. The plant is more canescent, and the stems fork once or twice. It lies between *E. stenophyllum* and *E. filifolium.* — Southern Utah, Mrs. A. P. Thompson, Captain F. M. Bishop.

Eaton's E. STENOPHYLLUM, Bot. King, p. 152, t. 17, a homonym, is his *Aster arenarioides,* vide supra. Nuttall's earlier *E. stenophyllum* in Pl. Gamb. is his *E. foliosum,* with narrower leaves.

E. ERVENDBERGII. Strigoso-hirsutulum; caulibus e basi decumbente erectis gracillimis inferne crebre foliosis superne longe nudis monocephalis; foliis lanceolatis basi attenuatis integerrimis vix pollicaribus; involucri squamis subæqualibus strigoso-puberis; ligulis 50-60 angustis elongatis ut videtur albis; ovariis glabellis; pappo radii discique duplici, exteriori e setulis numerosis basi vix concretis diametro ovarii æqualibus, interiori e setis uniseriatis fragilibus subdeciduis. — Wartenberg, Mexico, Ervendberg, no. 69. Root not seen; slender stems a foot high. Head about as large as in *E. strigosum.*

E. DELPHINIFOLIUM Willd. Bentham, in Gen. Pl. p. 281, suspects that the New Mexican plant of Wright, no. 1170 (with which agrees Thurber's 771, and Palmer's 421 from Arizona), is different from the original Mexican species. The exterior pappus indeed consists of rather narrower and longer squamellæ; but otherwise I see no difference.

ACHÆTOGERON Gray, Pl. Fendl. p. 72. This is overlooked in the Genera Plantarum; else it would probably have been referred to *Erigeron* as a sort of *Phalacroloma* without bristles either in disk or ray. But technically, and perhaps with sufficient reason every way, it should hold its rank as a genus in the *Bellideæ*, just before *Myriactis*.

BACCHARIS. The receptacle is *conical* in *B. Douglasii* DC.

EVAX. The paleæ of the receptacle vary from strongly carinate-cymbiform in some species (as in *E. Heldrichii*, in which they are wholly pointless) to barely concave in others: in *E. perpusilla* there are subtending and partly enclosing paleæ for each sterile flower. Our Californian *Hesperevax* may very well remain in the genus; but it constitutes a marked subgenus, not only on account of the firm and at length rigid, comparatively persistent involucral scales and paleæ which are barely concave, but also on account of the receptacle. This is not correctly represented on the plate in Bot. Whippl. Exped. The body of it, on which most of the fertile flowers are borne, is rather convex than conical, beset with villous hairs, which are fully as long as the achenia, and abruptly produced at the centre into a narrow column, which bears very few or hardly any pistillate flowers and paleæ except near its base, while its summit bears a whorl of three to five, broadly ovate or obovate, blunt or sometimes mucronate, flat paleæ, of nearly herbaceous texture, more or less woolly inside, forming an involucre to the small cluster of hermaphrodite-sterile flowers, rigid and radiately spreading with age, at length deciduous. The achenia, moreover, are smooth (not papillose or glandular), clavate-obovate and decidedly obcompressed. The transverse brownish line above their base is marked in the coat of the seed. The diversity in the villosity of the receptacle, and the length and thickness of its elevated portion (being very slender, even filiform, and a line high, in no. 415 of Kellogg and Harford's collection), appeared to indicate more than one species, but I cannot make them out.

MICROPUS. The generic character in the Genera Plantarum by an oversight requires the fertile flowers to form only a single series. I should hardly change that; for the genus clearly appears to me to hold only the first two sections, and to rest on two good and peculiar characters: 1, the paleæ, which so completely and strictly enclose the achenia, are firm coriaceous or cartilaginous in texture, at length inclined to split into two valves; 2, the achenia are strongly gibbous, so that the style, with its filiform corolla, is lateral: the pappus wholly wanting. Consequently, —

Stylocline Nutt., with straight or hardly oblique achenia having a terminal areola (as in all *Filagineæ* except *Micropus*), and with its other good characters, is to be restored: it will well include Bentham's section *Diplocymbium* and my *Ancistrocarphus*, thus constituting a genus of at least four species, thus: —

§ 1. Eustylocline. S. gnaphalioides Nutt., S. micropoides Gray.

§ 2. Diplocymbium. (*Micropus* sect. 3, *Diplocymbium* Benth.) Flores fœminei biseriati; paleis tenui-membranaceis extus lanosissimis, apice scarioso mutico, iis circa flores steriles angustioribus minus involutis. S. Griffithii, *Gnaphalii* sp. Griffith, Notul. 4, p. 240, t. 468. Affghanistan, Griffith; no. 3220, 3221, Kew. distrib.

§ 3. Ancistrocarphus. Flores fœminei 5 – 10 uni – biseriati, paleis cymbiformibus fere *Diplocymbii* (sed minus lanatis firmioribusque) obvoluti, steriles paleis 5 majoribus ovato-lanceolatis subfoliaceis apertis in cuspidem incurvam rigidam desinentibus persistentibus fructiferis delapsis stellato-patentibus. — S. filaginea, *Ancistrocarphus filagineus* Gray, Proc. Am. Acad. 7, p. 356.

Psilocarphus Nutt. The most important thing to note is, that the leaves, even from the base of the stem, are almost always opposite. *P. globiferus*, i. e. the Chilian *Micropus globiferus* of Bertero (*Bezanilla Chilensis* Remy), as well as I can judge from a single specimen, is distinguishable from the North American species by its less elongated (narrowly elliptical-oblong) as well as smaller achenia. The northern species seem to be reducible to two, *P. Oreganus* and *P. tenellus*. Var. *elatior* of the former (Oregon, Hall, no. 271, Kellogg and Harford, 418) is a remarkably luxuriant state, a span high, and erect.

Filago Arizonica. Floccoso-lanata, a basi ramosissima, diffusa (spithamæa); ramis proliferis filiformibus; foliis linearibus brevibus, caulinis plerisque glomerulos terminales et alares involucrantibus; capitulis ovato-pentagonis; floribus fœmineis 10 – 15 epapposis, hermaphroditis (sterilibus?) 5 – 10 papposis; receptaculi angusti paleis ovatis, fructiferis cymbiformibus dorso chartaceo lanosissimis, apice hyalino brevi obtuso, interioribus subplanis scarioso-hyalinis acutiusculis; acheniis lævibus. — Arizona, at Verde Mesa, Dr. Charles Smart, coll.

1867, received from Dr. Parry. Habit of *F. spathulata*, proliferously dichotomous; the branches filiform and becoming glabrous. Heads numerous in the capituliform clusters, a line and a half long. Fructiferous paleæ almost as deeply saccate as in *F. Californica.*

ANAPHALIS MARGARITACEA. We prefer the reference of *Gnaphalium margaritaceum* Linn. to this genus (standing between *Antennaria* and *Gnaphalium*), rather than to *Antennaria* by Brown, or to *Helichrysum* by Weddell. No. 300 of E. Hall's Oregon collection, inadvertently named *Gnaphalium leucocephalum* Gray, is a narrow-leaved form of our common Everlasting.

PTERIGOPAPPUS Hook, f. Although *Maia* of Weddell is referred to this genus in the Genera Plantarum, only the original Tasmanian species is mentioned. *P. compactus* from the Andes of New Grenada is the second species of this singularly distributed genus.

ADENOCAULON Hook. Bentham refers this genus to his *Millerieæ* in the tribe *Helianthoideæ*, with evident misgiving, remarking in his Notes on the order that it is a less perfect stranger there than by the side of *Tussilago*. That is true enough; but the wholly alternate leaves and naked receptacle are out of place there, and there is nothing but the sterile central flowers which favors the association. Upon a study of our species for the Californian flora, I find that its anthers, instead of "basi integræ vel vix minute bidentatæ," are strongly sagittate, in the manner of Bentham's diagram, no. 6, except that the five points of the auricles are obtuse, although quite as much produced. The style being conformable, it is clear to me that the genus should be transferred to the *Inuloideæ*, where, from its peculiarities of fruit, involucre, and corolla, it may form a subtribe, *Adenocaulóneæ.*

AMBROSIA ARTEMISIÆFOLIA, etc. In his notes on Compositæ, and more briefly in Genera Plantarum, Bentham has cited an observation of Meehan, that in this plant "the inflexed setiform appendage is only to be found on anthers which do not present perfect pollen; the abundantly polleniferous anthers are broad, without horns." I find this appendage equally surmounting anthers that have been filled with pollen, and those that are so filled, only in the latter they are not so readily discerned. I have never seen any normal staminate heads with non-polleniferous anthers.

SILPHIUM GRACILE. Scabro-hispidulum; caule gracili striato 1–2-pedali mono–tricephalo subscapiformi; foliis radicalibus imisque caulinis ovato-oblongis membranaceis denticulatis utrinque acutis vel acuminatis longe petiolatis alternis, superioribus parvis paucis interdum oppositis lanceolatis sessilibus integerrimis; involucri squamis conformibus subæqualibus erectis ovato-lanceolatis ciliolatis basi nervosis; ligulis 12 – 15; acheniis cum ala latissima tenui orbiculatis sinu lato emarginatis lævibus. — Open woods, Texas, near Houston, Lindheimer (anno 1842, ex Engelmann), E. Hall, 1872. The radical leaves in Lindheimer's specimen are larger, 10 to 15 inches long, including the slender petiole, and pubescent beneath. Hall's plant has smaller leaves and less pubescence.

ZINNEÆ Benth. This subtribe of *Helianthoideæ* appears to be well founded, by Bentham, upon six Mexicano-North-American genera; and, as he remarks, our *Heliopsis* of the United States seems to hold its sessile ligules as persistently on the fruit as does the Mexicano-South-American species. But the use which is made of this character might call for the addition to the subtribe of a species which I long ago characterized as forming a subgenus of *Balsamorhiza*, and which has remained unnoticed, namely:—

BALSAMORHIZA (KALLIACTIS) CAREYANA Gray, Pl. Fendl. p. 81. In this the ligule becomes as dry and papery as in any *Zinnia*, and is equally persistent; but while the latter is continuous, the former has the short tube of the ligule evidently articulated with the summit of the achenium. The styles, etc., being exactly as in *Balsamorhiza*, the species ought not to be separated from that genus. But it further differs from all the other species in its cinereous-pubescent achenia.

WYETHIA Nutt. In a natural arrangement this genus should stand near to the preceding, to which it is much more related than to the proper *Helianthus*-group. The pappus is of the coroniform order, and perfectly continuous with the broad summit of the achenium, which is very obtusely quadrandular in the typical *Alarconia* and its near ally; the sides in all are nerved. The species, as far as known, are subjoined.*

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* WYETHIA Nutt. (ALARCONIA DC.)

§ 1. Achenia crassa, quadrata, angulis obtusissimis, pappo calyciformi 5 – 8-fido rigido coronata. Capitula magna, latissima, foliaceo-bracteata, seu involucrum foliaceum amplum. Folia lata, amplissima.

1. W. HELENIOIDES Nutt., Gray, Pl. Fendl. Tomentosa vel tomentulosa; acheniis cinereo-puberulis; dentibus corollæ disci extus parce hispidulis. *Alarconia*, DC.

2. W. GLABRA Gray, Proc. Amer. Acad. 6, p. 543. Glabra, glutinosa; acheniis glabris; dentibus corollæ disci brevioribus glaberrimis.

TITHONIA THURBERI. Caule gracili superne hispido; foliis ovatis indivisis; capitulo pro genere parvo; involucri squamis obtusis, exteri_

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§ 2. Achenia angustiora angulis acutis, disci saltem lateraliter compressa. Capitula mediocra, nuda, rarius basi foliata.

* Albo-tomentosa, vel demum glabrescens, foliis latis petiolatis, caule nunc ramoso.

3. W. OVATA Gray, l. c. 7, p. 357. Tomentoso-pubescens; foliis lato-ovatis cordatisque; involucri lato-hemisphærici squamis plurimis apice patentibus; pappo paleaceo-calyciformi brevi exaristato.

4. W. MOLLIS Gray, l. c. 6, p. 554. Albo-lanata, nunc glabrescens; foliis oblongis summisve ovatis reticulatis; involucri campanulati squamis 10 – 12 latioribus erectis discum superantibus; pappo præter coronulam truncatam 2 – 5-aristato.

* * Glaberrima, foliis angustioribus, caulinis sessilibus.

5. W. AMPLEXICAULIS Nutt. Involucrum campanulatum. Pappus vix ac ne vix aristiformis.

* * * Hirsuto-pubescens, foliis lanceolatis.

6. W. HELIANTHOIDES Nutt. Pygmæa, pube laxa subvillosa; involucro etc. subsequentis; pappo brevi exaristato rariusve arista unica gracili.—This is Nuttall's original *Wyethia*, founded on specimens, in flower only, collected by Wyeth "in the Valleys of the Rocky Mountains near Flat-Head River" (as it would appear in about lat. 47° long. 114°), to which Nuttall afterwards added a plant collected by himself "near the Blue Mountains of Oregon." The species is imperfectly known, and seems to differ from the next mainly in the awnless or occasionally one-awned pappus. I cannot well examine the interior of the single capitulum of Wyeth's specimen in our herbarium. A few separate flowers from one of Nuttall's own collecting are awnless.

7. W. ANGUSTIFOLIA Nutt. *Spithamæa ad ultrapedalem; foliis radicalibus* elongatis utrinque attenuatis; involucro polyphyllo patente, squamis plerisque foliaceis lato-linearibus nunc subspathulatis sæpius obtusis aut undique aut ad margines pilis longis hirsutis; acheniis interioribus 1 – 2 extimis sæpius 3 – 4-aristatis, arista valida hirta. *Alarconia angustifolia* DC. *Wyethia robusta* Nutt. is merely one of the larger forms of this common species of California and Oregon.

8. W. ARIZONICA. Pedalis, scabro-hirsuta; caule 1 – 2-cephalo; foliis oblongo-lanceolatis integerrimis, superioribus sessilibus; capitulo parvulo; involucro hemisphærico, squamis oblongo- seu ovato-lanceolatis (ut videtur erectis) pilis brevibus cinereo-hirsutis; corollæ dentibus extus hispidulis; ligulis circiter 10 (subpollicaribus); acheniis immaturis fere præcedentis. In pine woods and bottoms, near Bear Springs, Northern Arizona, Dr. E. Palmer. Also Southern Utah, Captain F. M. Bishop; a less hirsute form.

* * * * Hispido-scaberrima, foliis linearibus, ligulis nullis ?

9. W. SCABRA Hook. Lond. Jour. Bot. 6, p. 245; Gray in Bot. Whippl. p. 46 (102). This little known species of Utah ? and New Mexico, is peculiar in habit, and perhaps in the absence of rays; very likely it is not of this genus.

oribus parce hispidis breviter foliaceis; ligulis brevibus aurantiacis; pappi squamellis lineari-oblongis coriaceis, aristis parum scabris. *T. tubæformis* Bot. Mex. Bound. p. 90, non Cass. — Magdalena, in the Mexican province of Sonora, Thurber, no. 910. This species is indicated by Bentham, in Gen. Pl. p. 375. In the genus now reduced to its natural proportions and well characterized, it is the smallest flowered species, the heads being only half an inch long, and the ligules short.

FLOURENSIA DC. As to *F. corymbosa*, if C. Gay's plant of the name is genuine, it is clearly a *Viguiera* (as that genus is now well characterized by Bentham), and the character "achenia villosissima" (DC) is not applicable, as it is to the genuine species. These I cannot regard as belonging to *Helianthus*. They appear to be quite different in habit, and hardly less so in the style, corolla, and achenia; and the pappus, seemingly not caducous even in *F. thurifera*, is marcescent in the more genuine discoid species, *F. laurifolia*, and persistent in the anomalous *F. cernua*. *F. laurifolia* and *F. thurifera* are not so very dissimilar in habit; both have the chaffy awns of the pappus disposed to be trifid, and want the accessory nerves to the corolla. *F. cernua*, which shows these nerves, but is otherwise most unlike *Helianthus*, and has turgid instead of flat achenia, still accords with *Flourensia* in most respects.

ENCELIA Adans. The combination which I had proposed of *Geræa* and *Barrattia* with *Sinisia* is justly carried a step further by referring all these to sections of *Encelia*. I have detected rudimentary awns to abortive ray-achenia in specimens which in Bot. Mex. Bound. I had referred to *E. conspersa* Benth. (a species still obscure), but should now regard as a mere variety of *E. Californica*. This species is distinguished from the Chilian *E. oblongifolia* by the leaves more obtuse at base, and the achenia with a much shallower emargination. The species of the section *Geræa* are: —

ENCELIA (GERÆA) NUDICAULIS. Herbacea, pube brevi densa argenteo-canescens; foliis omnibus radicalibus orbiculatis integerrimis basi 3–5 nervata in petiolum nudem latiusculum longum subito angustatis; scapo subpedali prorsus nudo monocephalo; involucri incani lati squamis triseriatis lanceolatis discum subæquantibus; ligulis ultra 20 lanceolatis pollicaribus cum floribus disci aureis; acheniis obovatis undique villosissimis marginibus apiceque callosis; pappo ex aristis 2 subulatis sat validis pilos haud superantibus et squamellis intermediis minimis plurimis e membranulo fere continuo brevissimo ortis. —

— Utah, probably in the southern part of the Territory, Captain F. M. Bishop. This remarkable species, with head fully as large as that of *E. Californica*, on a perfectly naked scape, departs a little from the generic character in having minute and short somewhat membranaceously connected squamellæ between the awns, of which mere vestiges persist on the mature achenium.

ENCELIA (GERÆA) ARGOPHYLLA. This is the name which must be borne by a close congener of the preceding, the *Tithonia argophylla* of Eaton in S. Watson, Bot. King, p. 423, if the most scanty materials on which it was founded belong to one plant, as is likely. The foliage described consists of tufts of radical leaves, which are exceedingly silvery-white with a very dense and close-pressed, short, soft silky down, all rhombic-spatulate with long-tapering base and abruptly acuminate or acute apex. The separate and fragmentary head, so far as the means of comparison exist, might be identical with that of the preceding species at maturity. Its achenia are four lines long; the very numerous and fine intermediate squamellæ are, however, apparently more setulose. "Dr. Palmer describes the stem as erect, two or three feet high, leafy, with cauline leaves similar to the radical ones." He informs us that it was found at St. George, in Southern Utah.

ENCELIA (GERÆA) ERIOCEPHALA, *Simsia canescens* Gray, Bot. Mex. Bound. p. 89, the specific name changed on account of the old *Encelia canescens*. It is remarkable for the long and white villous hairs which densely fringe the lax and linear-lanceolate herbaceous scales of the involucre; and the awns of the pappus are naked.

ENCELIA (GERÆA) FRUTESCENS, *Simsia frutescens* Gray, l. c., to the character of which it should be added that the rays are more commonly present, 6 to 12 in number, and 3 – 4-lobed.

ENCELIA (GERÆA) SCAPOSA, *Simsia scaposa* Gray, Pl. Wright. 2, p. 88. Still known only from Wright's New Mexican collection. The disk-corollas are yellow; the thin chaff of the receptacle acutish. — Nearly related to this is

ENCELIA (GERÆA) MICROCEPHALA. Herbacea, puberula; caulibus e radice perenni erectis strictis pedalibus apice corymboso-oligocephalis; foliis scabro-hispidulis integerrimis subcoriaceis, radicalibus cum caulinis infimis oppositis spathulato-lanceolatis obtusis triplinerviis in petiolum attenuatis, cæteris minoribus alternis lineari-lanceolatis (subpollicaribus), superioribus sensim decrescentibus; involucri campanulati disci brevioris squamis oblongis gradatim imbricatis subcori-

aceis; ligulis paucis (flavis) brevibus; disci corollis atro-purpureis, paleis obtusissimis vel truncatis; acheniis (immaturis) undique villosissimis 1–2-aristatis, aristis basi villosissimis. — Sierra Abayo, New Mexico? Dr. Newberry in McComb's Expedition. Heads 2 to 4, on rather short peduncles, only 4 lines high; the oblong rays hardly exceeding the disk.

ENCELIA (GERÆA) ALBESCENS. Herbacea? pube sericea brevi scabrida argenteo-canescens; foliis (ramealibus) alternis ovato- seu lanceolato-oblongis subintegerrimis basi subcuneata trinervatis breviter petiolatis; capitulis solitariis longius pedunculatis; involucri biserialis squamis lanceolatis æqualibus canescentibus; floribus luteis; ligulis 8–10 obovatis majusculis; paleis receptaculi acutis; acheniis (immaturis) cuneato-oblongis præter margines creberrime sublonge ciliatos fere glabris; pappo 1–2-aristellato nudo. — In the western Mexican province of Sonora, Dr. Edward Palmer, coll. 1869, no. 21. Leaves in the specimen less than an inch long, the short petioles not dilated at base. Rays half an inch long. Young achenium slightly emarginate at the apex, the dense ciliate hairs of the margin in length scarcely equalling half its width, or at the summit rather longer, and about half the length of the longer delicate naked awn of the pappus, the other awn seldom longer than the hairs, often shorter or obsolete. In aspect and in the nature of the pubescence this very much resembles another scarce Composita of the same region, namely, *Viguiera nivea* (supposing it to be the *Encelia nivea* of Bentham, Bot. Sulph.), the plant described by me in Bot. Mex. Boundary as *Helianthus tephrodes*. That, by the pappus and ovary, is evidently a *Viguiera*. The present plant is a good *Encelia*, of the *Geræa* section by the pappus, although the awns are unusually delicate and one of them inclined to disappear. The villous ciliation of the achenium, although shorter than in its congeners, is too long and dense for a *Simsia*.

ENCELIA (BARRATTIA) CALVA, *Simsia calva* Gray, Pl. Lindh. 2, p. 228, is remarkable for the pair of foliaceous stipule-like appendages at the base of uniformly opposite leaves. These are altogether wanting in

ENCELIA (BARRATTIA) GHIESBREGHTII. Herbacea? ramosa; ramis gracilibus foliosis; foliis omnibus oppositis angusto-ovatis acuminatis rariter serratis basi truncatis vel subcordatis supra hirtello-velutinis subtus molliter canescenti-sericeis; petiolis brevibus inappendiculatis; involucro campanulato *Simsiæ*, squamis lineari-subulatis villosis

glandulosisque, interioribus discum adæquantibus; floribus luteis, ligulis 10–12 oblongis (subtus lividis?); paleis receptaculi cuspidato-acuminatis; acheniis (immaturis) oblongis glaberrimis apice truncatis calvis. — Mountain forest near Chiapas, S. Mexico, Ghiesbreght, no. 568, of recent distribution; very scantily collected. Branches slender, glandular-scabrous and beset with spreading villous or hirsute hairs. Leaves one or two inches long, the pubescence appressed, that of the lower surface especially soft and satiny. Involucre half an inch high. Rays barely half an inch long. Mature akenes not seen; the immature ones flat, truncate at summit, not at all emarginate or bidentate.

COREOPSIS Linn. In the Genera Plantarum this genus is probably extended too far when made to comprise groups of species with fertile rays. At least in the Flora of California I am constrained to reinstate two genera which are peculiar to that region, and in which no true *Coreopsis* occurs, although, indeed, the genus does cross the Rocky Mountains and reach the Pacific in a single species farther north. As to the African section *Prestinaria*, it might be associated with, or form a part of *Diodonta*. *Epilepis* Benth., the rays of which are said in the Genera Plantarum to be fertile, but are more correctly described in Plantæ Hartwegianæ as neutral, and those opposite-leaved South American species which I once associated with *Agarista*, I should still regard as belonging to *Coreopsis*, while I would re-establish the California genus, under the name of

PUGIOPAPPUS Gray.

Capitulum multiflorum, heterogamum; floribus radii 7–10 fere semper *fœmineis*, disci hermaphroditis. Involucrum duplex *Coreopsidis*. Receptaculum planum, paleis scariosis cum fructu deciduis onustum. Ligulæ latæ, truncatæ, plurinerviæ. Corollæ disci tubo tenui versus apicem annulato, limbo ampliato 5-lobo. Styli fl. radii breves, nunc intra tubum ligulæ retracti; fl. disci ramis cono brevissimo superatis. Achenia plano-obcompressa, ovalia vel oblonga, radii glaberrima, marginata vel alata, calva; disci villosa vel ciliata, cum palea receptaculi adpressa basi cohærente decidua, pappi aristis paleolisve longis triquetris pugioniformibus superatis. — Herbæ annuæ, Californicæ, glaberrima, foliis alternis 1–2-pinnatipartitis, lobis linearibus, capitulis solitariis longe pedunculatis, floribus aureis. — *Agarista* DC. Prodr. 5, p. 569; Torr. & Gray, Fl. 2, p. 337, non Don. *Pugiopappus* Gray in Bot. Whippl. p. 48, & Proc. Amer. Acad. 6, p. 545.

It was long ago remarked, in the Flora of North America, that ovaries of the ray in *Agarista calliopsidea* DC. are ovuliferous. I have lately seen, in a cultivated plant, that they are equally if not more fertile than those of the disk. The specimens under cultivation showed well-formed styles to the ray-flowers; but these I find are present in all the indigenous specimens I possess, although commonly short or even included in the tube. *Agarista* DC. and *Pugiopappus* are therefore congeneric. As Don's *Agarista* in *Ericaceæ* is earlier, and is to be restored, the present reinstated genus naturally takes the name of *Pugiopappus*. The species are: —

PUGIOPAPPUS CALLIOPSIDEA. Caule 1–2-pedali inferne folioso; capitulo majore; involucri exterioris squamis ovatis basi coalitis; ligulis cuneato-obovatis (semipollicaribus ad pollicarem); disci corollis tubo piloso-annulato; achenis radii latis ala tenui cinctis, disci margine intusque longe mollissime villosis. — *Agarista calliopsidea* DC.

PUGIOPAPPUS BREWERI. Minor; foliorum lobis angustissime linearibus; involucri exterioris squamis linearibus; ligulis oblongo-spathulatis (semipollicaribus); annulo corollæ disci obscuro imberbi; acheniis radii præcedentis, disci secus margines costamque paginæ interioris tantum longe villosis; pappi aristis validioribus achenio dimidio brevioribus. — This is the plant, collected by Professor Brewer (no. 241) "on dry hills at San Buenaventura," below Santa Barbara, which in Proc. Am. Acad. 5, p. 545, I wrongly referred to *P. Bigelovii*. It is nearer the preceding.

PUGIOPAPPUS BIGELOVII Gray, l. c. Humilis; foliis subradicalibus carnosulis, segmentis paucis angustissime linearibus; capitulo in pedunculo scapiformi parvulo; involucri exterioris squamis lato-linearibus; ligulis quadrato-oblongis; annulo corollæ disci imberbi; acheniis radii oblongis ala crassiuscula marginatis, disci (ut videtur plerumque sterilibus) tenuiter ciliatis. — The style in the disk-flowers is articulated above the base, and the thickish basal portion is less deciduous, in all three species. In those, also, the disk-achenia, or some of the central ones, are disposed to be infertile.

LEPTOSYNE DC., with its three genuine species and *Tuckermannia* of Nuttall, which I long ago referred to it, has perhaps still greater claim to be regarded as a good genus. *L. Douglasii* DC., *L. Stillmanii* Gray, and *L. Newberryi* Gray, differ chiefly in some details of flowers and fruit; in the latter the cup or little border which answers to pappus is almost obsolete. There is no trace of it in the remarkable section *Tuckermannia*, *L. maritimia* Gray, which is reinforced by a succulent woody-stemmed species of the Californian Islands, *L. gigantea* Kellogg. This, however, has not yet flowered here in cultivation. It may be only an insular variety of the other.

Although not here in its proper place, I close the present portion of this article with the characters of the following interesting genus: —

MESONEURIS, Nov. Gen. *Senecionidearum.*

Capitulum homogamum, multiflorum, floribus hermaphroditis tubulosis. Involucrum campanulatum, bracteolis lineari-filiformibus paucis laxis stipatum; squamis 12 – 15 biseriatis æqualibus oblongo-lanceolatis, medio concavis subherbaceis 3 – 5 nerviis, basi incrassatis (carnosis?) marginibus pl. m. scariosis. Receptaculum convexiusculum, epaleatum, fimbrillis subulatis inter flores. Corollæ hypocraterimorphæ; limbo usque ad tubum angustum æquilongum 5-partitum, lobis linearibus marginibus æstivatione induplicatis, medio nervo valido percursis, nervis intramarginalibus tenuissimis. Stamina fauci inserta: antheræ lineares, basi breviter bidentatæ. Styli rami crassiusculi subcomplanati, extus puberi nervo medio valido percursi, apice subtruncato magis hirtelli. Achenia cylindracea, enervia, areola epigyna (modo *Senecionum*) annulo magno incrassato circumdata. Pappus e setis rigidulis scabris uniserialibus corollæ tubum haud superantibus. — Herba austro-Mexicana, foliis alternis bipinnatifidis, petiolo basi spathaceo-auriculato caulem amplectente, capitulis cymosis, floribus albis.

M. BIPINNATIFIDA. — Mexico, in the cold region of the mountains, province of Chiapas, Ghiesbreght, no. 805 of new collection. — somewhat robust perennial, two or three feet high, and probably often taller, with some lax and deciduous pubescence, woolly-tufted at the base of the stem. Lower leaves a foot long, including the petiole; the foliaceous sheathing auricle an inch or two in length; uppermost leaves reduced to these spathaceous sheaths. Heads half an inch long. Lobes of the corolla 2 lines long; the tube 5-nerved below, the nerves as usual running to the sinuses, their continuation within the margin of the lobes very slender: the median nerve of the lobes more prominent than in the other and rare cases in which it is manifest at all, but gradually vanishing after reaching the tube. The genus is a remarkable one on several accounts (and doubtless Senecioneous although the corolla recalls *Hymenothrix*): in deriving the name from the nervation, I have taken the less-used diminutive *νευρῖς*, so as not to come too near *Mezoneuron*.

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